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Shipbuilding Outlook

THE latest reports from the Department of Commerce show that the United States is not only building more merchant shipping at the present time than any other country in the world, but that the output of American shipyards for the year 1916 will probably exceed that of all the rest of the world. On July 1 there were no less than 385 steel merchant vessels of 1,225,784 gross tons building or under contract to be built in private American shipyards, and in addition there is now before Congress a naval appropriation bill providing for the largest building programme in the history of the country. Barring delays, the shipbuilders expect to launch 327 steel ships of 927,893 gross tons during the current fiscal year and 58 vessels of 297,891 gross tons during the following fiscal year. With the continuation of the European war there is little doubt but that the latter figures will be greatly exceeded, provided labor troubles do not diminish the output and steel makers are able to meet the demands of the shipbuilders.

With such a favorable outlook there is good reason for the continued expansion of existing shipbuilding facilities in the United States and the addition of new yards to meet future demands. The naval appropriation bill in the form in which it passed the Senate on July 21 provides for the construction of no less than 157 vessels of approximately 855,000 tons displacement, 66 of which, of about 382,000 tons displacement, are to be begun as soon as practicable, and the remainder before July 1, 1919. To carry out such a liberal programme of naval construction the nation must look as heretofore to the initiative and enterprise of private shipbuilders. The facilities of naval establishments for shipbuilding are entirely inadequate to cope with such a programme, and the delays involved in providing the necessary facilities in the navy yards to undertake more than a small part of such work effectively would defeat the purpose of the programme.

Merchant Submarines

WHILE the submarine boat was developed primarily as a war vessel, its possibilities for commercial purposes have frequently been pointed out in these columns. Its field of usefulness in commercial work, however, has been conceded to lie in the direction of hydrographic work, scientific investigations below the surface of the sea, recovery of lost cargoes, dredging, wrecking and other underwater enterprises, rather than in the direction of commercial transportation. The exigencies of war and blockade at sea, however, have furnished the opportunity for the entrance of the submarine into the field of maritime commerce, and during the past month the first merchant submarine has made its appearance at a United States port after a voyage of about 3,800 miles from Bremen, Germany.

The enterprise, skill and courage shown in successfully carrying out this difficult undertaking are fully recognized, and presumably the results from a commercial standpoint will repay the risk involved, as the *Deutschland* is but the first of a fleet of similar vessels which are being constructed for this service. The *Deutschland* is about 315 feet long, 30 feet beam, and on a draft of 17 feet has a displacement of about 2,000 tons. Her cargo carrying capacity is about 700 tons and her speed when driven on the surface by two four-cylinder Diesel engines of 600 horsepower each is from 12 to 13 knots. The submerged speed is slightly less than half the surface speed.

While the construction and performance of the vessel, so far as disclosed, reveal no unusual features from an engineering standpoint, the nature of the undertaking is sufficiently unique to center public attention upon her exploits as a pioneer submarine merchantman. It will be remembered that even more hazardous voyages of greater length have been successfully accomplished since the beginning of the war by naval submarines.

Geared Turbine Driven Tank Ships

SINCE the steam turbine was first adopted for the propulsion of ships, no other development has given greater promise of universal application than the introduction of speed reduction gearing between the turbine and the propeller shaft. The gradual perfection of different forms of gearing for this purpose has led to the possibility of the general application of economical high speed turbines to single screw slow speed cargo boats with advantageous savings in machinery weights and fuel consumption.

Elsewhere in this issue will be found descriptions of two tank steamers of somewhat different types, but of nearly the same size, both of which are fitted with turbine drive through mechanical reduction gears. In both cases the vessels are duplicates of other ships either built or under construction, equipped with other types of propelling machinery, so that after the vessels are in service valuable comparisons of their relative performances can be made.

One fleet of ships is designed for carrying either molasses or petroleum in bulk and the other for the carriage of oil. In the turbine driven molasses tank steamer the propelling machinery consists of a five-stage Curtis turbine, driving a single right-handed propeller through a double reduction gear. The turbine is designed to run at about 3,300 revolutions per minute and the propeller at 75 revolutions per minute, making a speed reduction of 30.6 to 1. The gearing is arranged in two elements, the high speed gear consisting of a single high speed pinion

driving two double helical wheels, and the low speed gear consisting of two pinions driving a single double helical wheel.

In the turbine driven oil tanker described in the second article the propelling machinery is of the Westinghouse type, consisting of a cross compound, double reduction geared turbine unit, running at 3,600 revolutions per minute and driving a single propeller at 70 revolutions per minute. The shaft horsepower developed by the turbines is 2,500 and the total machinery weighs only 68.7 tons, making the weight of the machinery 61.5 pounds per shaft horsepower, or 56.5 pounds per indicated horsepower, as compared with about 110 pounds per indicated horsepower for reciprocating machinery of the same power.

The Status of Cargo Handling in American Marine Terminals

BY JAMES A. JACKSON AND ROBERT H. ROGERS *

THIS article is a digest of two papers by the above writers, read before the International Engineering Congress in San Francisco in September, 1915. The natures of the papers are such that the salient points are readily combined in this article to indicate the status and trend of the methods and apparatus used in the handling of bulk and package cargoes in our marine terminals.

Bulk freight consists of free-flowing material, such as coal, ore, grain, certain fertilizers, etc., which can be transported and handled in bulk. The classification of bulk freight can be carried only two steps, viz., kind of material and weight; and this simplicity has been a large factor in the development of the rapid means now used for handling such freight.

The history of the handling of bulk or free-flowing freight makes interesting reading, and there is probably no better place to follow it out than on our own Great Lakes, where the development of rapid, economical handling has been carried to a very high degree. With this development of freight handling our readers are thoroughly familiar.

Miscellaneous or package freight, however, presents the most serious problem, as it forms the greater part of all freight, both in weight and bulk. The varying size, shape, strength and weight of packages make its classification an endless task; a single cargo often containing 50,000 to 100,000 packages, divided into hundreds of different sizes, shapes and weights, and consigned to several hundred different parties. The transportation companies have an elaborate system of classifying this package freight to determine the freight charges, but such a classification would be of little value so far as handling is concerned. A classification based on size, weight and shape would be the logical way of attacking the problem.

Miscellaneous or Package Freight

The greatest advance toward dispatch and economy is attained in terminals by the use of mechanical devices for handling freight in and out of ships, to and from storage piles and warehouses, and into and out of cars. Many of the larger and more progressive ports are investigating and testing various electrical machines, and there is, at present, quite a commendable quantity of such machinery in the package freight work; but the surface has hardly been disturbed as yet, either in the design of such devices or in their general adoption. A brief review of progress, to date, along these lines is too important to be omitted.

* Power and Mining Engineering Department, General Electric Company.

Winches

Electric winches, single, double, and with one or two motors, are in quite general use to supplant or supplement the ship's cargo winches. Head frames are provided on pier buildings to accommodate one whip, while the other is trained through the block or the ship's boom. Such apparatus provides greater speed, with greater safety, than is the case with steam, due to the uniform speeds, ample power braking and quickness of control that electricity provides. The most recent innovation in this country in this line is the use of a double portable master-controller carried by the winch operator, which gives him perfect control of both drums from any convenient position on the ship, or elsewhere. The advantage of always having the draft in sight adds greatly to the dispatch, and this end can be attained in no other way.

Conveyors

Sectionalized portable conveyors of ingenious design and great utility are rapidly becoming common on the piers, where they are used to discharge from the decks of ships, lighters or barges to the pier or storage pile, without rehandling. A single whip, or two working in multiple from the same hatch, supply the conveyor, which makes the horizontal transfer at great speed. A remarkable feature of this type of machine is its reservoir capacity, or flywheel effect, by virtue of the receiving area provided through its constantly presenting new empty surfaces to the loading device. Power consumption is very low, and the machines are not expensive to install or limited in their application.

Cranes

While much relied upon abroad, cranes are but little used along our coasts in the package cargo handling. Some of the most notable are: The banana conveyor cranes at New Orleans (ten in number), each with a capacity of forty-two bunches per minute; the battery of cargo cranes at Balboa, Panama Canal; and the variety of types seen about New York harbor, which, however, are largely used for lighters and barges.

So much depends upon the proper storage of cargo in ships that much improvement in dispatch in that direction cannot be looked for with package freight.

One of the most striking advances in dispatch is found in the use of a portable electric crane for loading and unloading gondola and flat cars.

Another system which speeds up internal movements of freight is the trailer and tractor plan, whereby simple platform four-wheel trucks are towed in groups by an electric tractor, which carries no load itself. Trailers are provided far in excess of the number towed at one time, so that the tractor never waits for loading or unloading, but picks up the trailers that are ready each time.

The pressure of factory production is as nothing compared with the pressure that traffic puts on the terminals. Each day's burden must be disposed of to make place for to-morrow's load. Like a man in a leaky boat, who must keep bailing or be swamped, the terminals are ever faced by the grave emergency of congestion, where dispatch is no more, and the trouble spreads to unbelievable distances along the arteries of commerce. The ample provision of varied and well-adapted machinery is the simplest method of attaining dispatch and retaining it.

Industrial Trucks

These little machines are readily operated by longshoremen, and when the surrounding conditions are right, they cut the costs of moving freight to a marked extent. They work to best advantage on packages that can be readily handled by one or two men, because each piece has to be

lifted on or off by hand, or by some other means. The distances must be rather great to make a good showing over hand trucks, and the approaches to loading and unloading points must be good.

Car Pullers

These machines may be vertical or horizontal; the vertical type can be set into a wharf, so that the drum only is visible. These pullers are very handy in minor car movements that would not warrant the calling of a switch engine. While the savings effected by these devices are indirect, they are nevertheless important. By moving cars from twenty to fifty feet the cost of unloading or loading them can sometimes be cut in two; whereas, without this convenience, hand bars would have to be resorted to or work done in an inconvenient manner.

Portable Cranes

The type using a storage battery for its source of power has a wide range of utility, with its most marked economies in the loading and unloading of gondola and flat cars. The machine, being a combined crane and electric truck, makes one handling of iron pipes, structural steel, timbers, logs, etc., between car and storage pile and gives the added advantage of economical tiering. Its greatest usefulness lies in short lifts of heavy weights, with moderate distance transfers. Another type is actuated by means of a motor having a cable leading to a receptacle or service station forming a part of the power distribution system. This machine is not self-propelling and is used principally to give unrigged barges, floats or lighters a rapid and economical cargo-handling equipment equal to or better than that of ships. These devices make the best showing on quantities of freight in units up to 1,000 pounds weight and requiring a considerable vertical movement. They discharge onto industrial trucks, trailers or hand trucks, or receive from them when loading boats.

Air, steam and water have been used to actuate cargo machinery; but just as electricity has superseded all other forms of power in all large industries, so will it be universally adopted for cargo handling machinery. Ship's boilers or donkey boilers should not be depended on for cargo handling machinery, as they have not proved reliable. Central station electric power is available in all port cities and is sufficiently reliable to meet the requirements demanded of it by dock machinery.

Direct current seems ideal for this service, as control and wiring problems are much simpler and more satisfactory than with alternating current. However, alternating current can be used satisfactorily, if necessary. With either direct or alternating current the most desirable voltage is from 220 to 250, from the standpoint of safety and insulation.

Terminal Accessories

Terminal accessories are of great importance and interest, and while not directly involved, they influence greatly the safety, despatch and economy of great commercial centers.

At large progressive seaports, particularly at those whose facilities are in part or wholly publicly owned, many provisions for the safety of rolling and floating property are to be found, and are becoming considered in a greater degree. Among these tendencies may be noted: The deepening, widening and straightening of approach channels, with improved buoying and lighting by Federal authorities, is doing much to make safe and easy the arrival and departure of shipping. Compulsory piloting, while deemed a hardship by some navigators, tends toward reducing losses by collision or grounding, especially in ports where tidal and current conditions are severe and changeable. The gradual increase in the size and power of harbor tugs and the wonderful skill of tugmen are factors agreeable to all who go down to the sea in ships.

In ports such as New York, where there is much car float traffic, recent improvements in floats and float bridges are notable additions to harbor and property safety features. The newer, all steel, watertight compartment floats, carrying twenty and more cars, are practically non-sinkable, and much more care and judgment is being used in the design and equipment of float bridges, thereby minimizing the damage to and loss of freight cars in this peculiar branch of traffic.

Design of Cargo Boats

In the design of cargo ships, many improvements are manifest, looking to speedier discharging and receiving. The new cargo boats have large steam winches in greater numbers than formerly prevailed; and well they may, for the standby charge on a moderate sized ship runs from $300 to $500 (62/10/0 to 104/3/4) per day, and money cannot be better invested than in facilities tending to shorten the stay in port. Modern coastwise ships are provided with more and larger side ports. It is a new and good practice to provide an elevated position for the cargo winches, leaving a clear deck for deck loads and placing the winch man in a more commanding position. Hatch covers have gone in for their share of attention, and the old standard strongback construction, with hand boards, is giving way to hinged steel trap doors of clever design that are quickly handled by the cargo winches and provided a certain closure when at sea.

The holds of the newer ships are free, or nearly so, from the stanchions that so profusely stud the working spaces of the older ships. The former tendency to specialize ships for certain cargoes has not been found expedient, as commerce does not usually provide similar cargoes both ways, consequently the normal cargo carrier is almost a universal ship. Donkey boilers are now of more liberal capacity, as in the older ships much delay is caused by lack of steam for all the winches without firing up the main boilers.

Summary

In review of the whole field the costs of handling freight through terminals is enormous as compared with the cost of hauling the same freight from place to place. The reason for this high cost is the universal use of manual labor, which has been retained largely because it is plentiful in the coast cities. The farmer has not adopted his wonderful machinery, to the almost entire exclusion of manual labor, from any love for machinery, but from dire necessity. His load factor is low, for his machinery is of special nature for seasonal work, a couple of weeks per year being an average condition. With the terminals, the load factor could be nearly 100 percent, but not being forced into its use by the absence of good labor, the terminals have been satisfied to work along the old lines. The use of machinery well adapted for the work has in many cases cut the labor costs to one-fourth the figure that formerly prevailed.

Broadly speaking, the future trend is toward more machinery for cargo handling. Three important steps must be considered in order to bring about the adoption of machinery: First, the educating of steamboat companies, stevedores and labor unions to see its advantage; second, the design of vessels and piers to be especially adaptable to the use of machinery; third, a systematic scientific study of freight and freight movements.

MOLASSES TANK STEAMER BUILT BY THE FORE RIVER SHIPBUILDING CORPORATION

Fig. 1.—S. S. *Sucrosa*

Fig. 2.—S. S. *Cubadist*

Geared Turbine Tank Steamer

Description of Sister Ships Built at the Fore River Yard for Carrying Molasses or Petroleum

AN interesting vessel recently completed by the Fore River Shipbuilding Corporation at Quincy, Mass., for the Cuba Distilling Company of New York, is the single screw, turbine reduction, gear driven steamer *Sucrosa*. This vessel, together with her sister ships, the *Cubadist,* recently delivered, and the *Mielero,* now under construction, were designed by the shipbuilders' naval architect to the owners' special requirements for the carriage of either molasses or petroleum in bulk between Cuba and ports of the United States.

As will be seen from the accompanying plans and photographs, the *Sucrosa* is a vessel of very pleasing appearance and of symmetrical, well-balanced design, and worthily upholds the enviable reputation the Fore River Shipbuilding Corporation has attained for designing and building high grade vessels.

The *Sucrosa* is a two-deck vessel with a top gallant forecastle, short bridge and long poop, with three masts and one smokestack and machinery located aft, and is of the following dimensions:

Length overall	406 feet 4 inches
Length between perpendiculars	389 feet
Breadth, molded	54 feet 6 inches
Depth, molded to upper deck	32 feet 6 inches
Designed draft	25 feet
Deadweight carrying capacity	8,120 tons
Gross tonnage	5,788
Net tonnage	3,608
Designed speed	11 knots

The vessel is built on the transverse system under the special survey of Lloyds Register of Shipping to Class 100-A-1, for carrying petroleum in bulk. Unlike the usual design of bulk liquid carrying vessels, the *Sucrosa* has a double bottom extending all fore and aft, being 4 feet 3 inches deep forward of the engine room and 6 feet deep under the machinery. The introduction of the double bottom has the effect of raising the center of gravity of the heavy molasses cargo which varies between 11 pounds and 14 pounds per gallon, and, furthermore, permits the provision of large wells in each main tank at the pump suction bell mouth, thus insuring an almost complete clearance for the cargo. When carrying molasses the cargo is carried in the main tanks above the inner bottom, while in carrying oil both the main tanks and the double bottom tanks are utilized, the latter having a pumping system independent of the former.

The *Sucrosa* is subdivided by 11 oiltight bulkheads, 2 watertight bulkheads and 2 non-watertight bulkheads, into 9 cargo tanks, a pump room, cofferdam, coal bunker, machinery space and fore and aft peaks.

The total capacity of the main cargo tanks is 2,342,500 gallons, and of the double bottom tanks 382,000 gallons, not including the tanks used for water ballast or reserve feed water. The coal bunkers have a total capacity of 930 tons, including a 15-ton bin for galley coal. The 'tween deck spaces outboard of the expansion trunk have a capacity of 50,200 cubic feet and are fitted up for the carriage of general freight with the frames battened.

Accommodations

Owing to the extreme heat often experienced in Cuban waters, special attention has been given to the arrangement of quarters and the ventilation of same, and, as will be seen from the accompanying plans, the quarters throughout the vessel are unusually large and airy and arranged with a view to the comfort and welfare of officers and crew. All cabins and main passageways to same are provided with individual ventilators, fitted with cowl top where used for supply and mushroom top where used as exhaust, in addition to which a large number of 12-inch electric bracket fans are furnished. The air to pump room is supplied through two 18-inch cowl vents, one of which may be, when desired, connected to a Sturtevant steam-driven exhaust fan of large capacity, which is used for drawing and expelling overboard the heavy fumes liable to generate and lay around the bottom of pump room when discharging cargo.

Accommodations are provided in the bridge space for the officers, with a saloon, guest room, pantry, baths and toilet. The captain's quarters are located in bridge deck house.

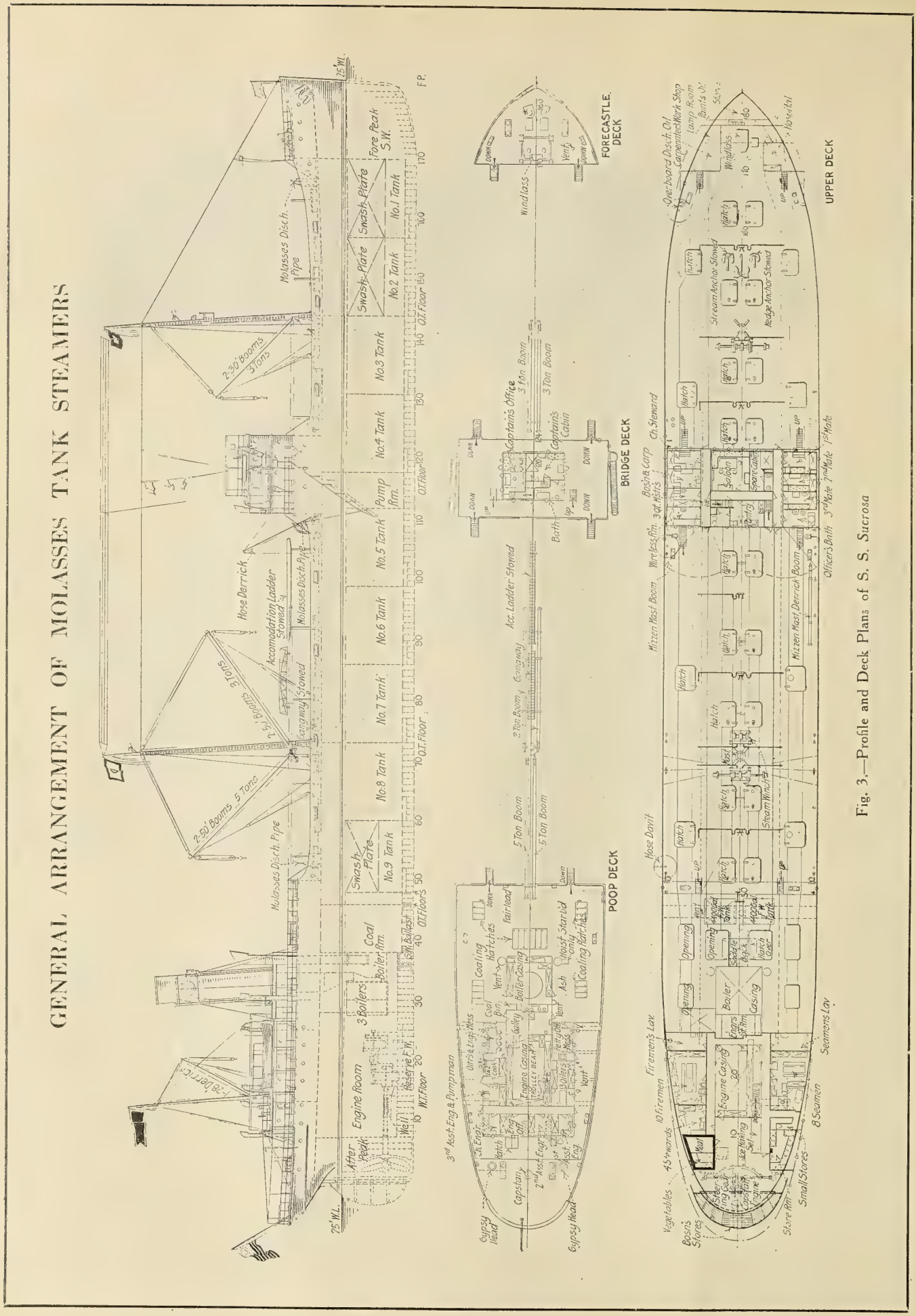
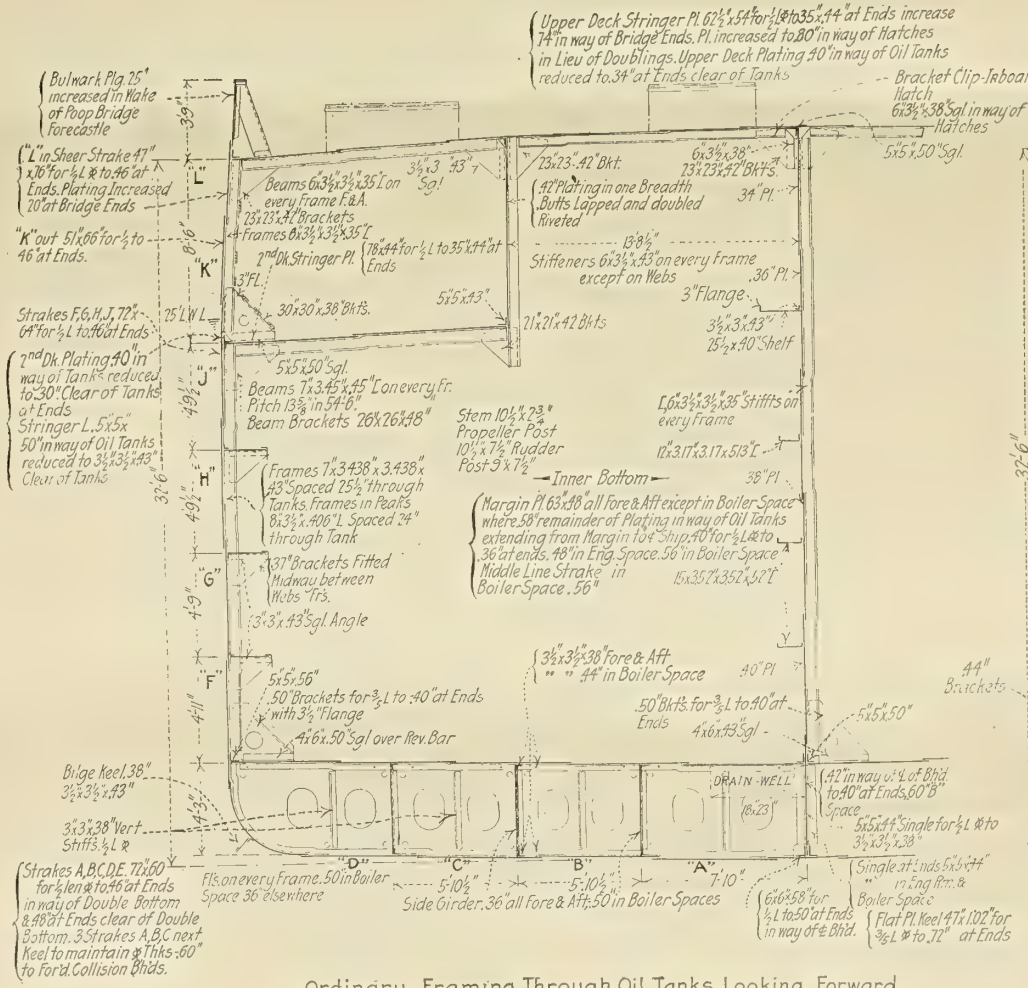


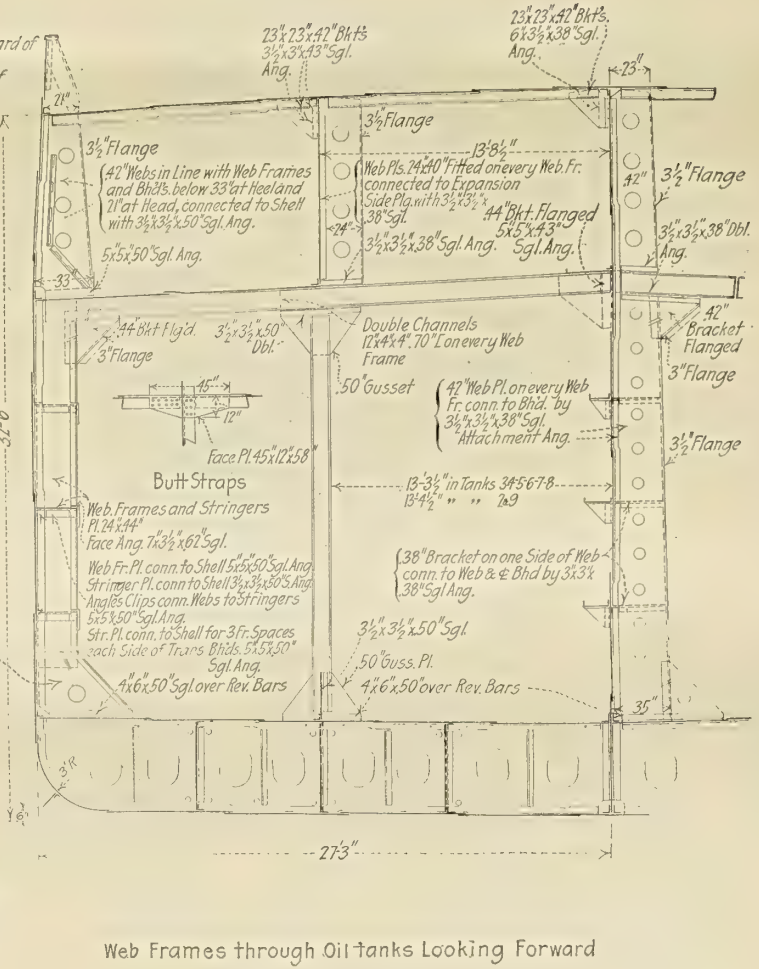
Fig. 3.—Profile and Deck Plans of S. S. Sucrosa

CROSS SECTIONS OF TANK STEAMERS, SHOWING SCANTLINGS


Upper Deck Stringer Pl. 62½"x54"for½L&to35'x44" at Ends increase 14" in way of Bridge Ends. Pl. increased to 80" in way of Hatches in Lieu of Doublings. Upper Deck Plating 40" in way of Oil Tanks reduced to 34" at Ends clear of Tanks
Bracket Clip-Inboard of Hatch 6x3½x38 Sgl. in way of Hatches
Bulwark Plg. 25" increased in Wake of Poop Bridge Forecastle
"L" in Sheer Strake 47" x76"for½L& to 46" at Ends. Plating Increased 20" at Bridge Ends
"K" out 51"x66"for½ to 46" at Ends.
Strakes F,G,H,J, 72"x64"for½L to 46" at Ends
2nd Dk. Plating 40" in way of Tanks reduced to 30" Clear of Tanks at Ends
Stringer L 5"x5"x50" in way of Oil Tanks reduced to 3½"x3½"x.43" Clear of Tanks
Beams 6"x3½"x3½"x.35" I on every Frame F.&A.
23"x23"x.42" Brackets
Frames 6"x3½"x3½"x.35" L
78"x.44" for½L to 35"x.44" at Ends
2nd Dk. Stringer Pl.
3"FL.
30"x30"x.38" Bkts.
5"x5"x.43"
5"x5"x.50" Sgl.
Beams 7"x3.45"x.45" I on every Fr. Pitch 13⅜" in 54'6" Beam Brackets 26"x26"x.38"
Frames 7"x3.438"x.43" Spaced 25½" through Tanks. Frames in Peaks 8"x3½"x.406" L Spaced 24" through Tank
37" Brackets Fitted Midway between Webs Frs.
3"x3"x.43" Sgl. Angle
5"x5"x.56"
.50" Brackets for¾L to 40" at Ends with 3½" Flange
4"x6"x.50" Sgl over Rev. Bar
Bilge Keel 38" 3½"x3½"x.43"
3"x3"x.38" Vert Stiffs. ½L &
Strakes A,B,C,D,E. 72"x60" for½len & to 46" at Ends in way of Double Bottom & 46" at Ends clear of Double Bottom. 3 Strakes A,B,C next Keel to maintain & Thks-.60" to For'd. Collision Bhds.
Fls. on every Frame .50 in Boiler Space 36" elsewhere
Side Girder .36" all Fore & Aft; .50" in Boiler Spaces
Stem 10½"x2.3" Propeller Post 10½"x7½" Rudder Post 3"x7½"
Inner Bottom
Margin Pl 63"x38" all Fore & Aft except in Boiler Space where 58" remainder of Plating in way of Oil Tanks extending from Margin to 4th Ship .40" for½L & to 36" at ends, 48" in Eng. Space .56" in Boiler Space
Middle Line Strake in Boiler Space .56"
23"x23"-.42" Bkt.
42" Plating in one Breadth Butts Lapped and doubled Riveted
6"x3½"x.38" 23"x23"x.42" Bkt's
34" Pl.
13'8½"
Stiffeners 6"x3½"x.43" on every Frame except on Webs
.36" Pl.
3" Flange
3½"x3"x.43"
25½"x.40" Shelf
21"x21"x.42" Bkts
L 6"x3½"x3½"x.35" Stiffts on every Frame
12"x3.17"x3.17"x.513" I
38" Pl
15"x.35"x3.52"x.51" I
3½"x3½"x.38" Fore & Aft
" " .44" in Boiler Space
.40" Pl
.50" Bkt's for¾L to 40" at Ends
4"x6"x.43" Sgl
5"x5"x.50"
.42" in way of ℄ of Bhd. to 40" at Ends, 60" B" Space
5"x5"x.44" Single for½L & to 3½"x3½"x.38"
Single at Ends 5"x5"x.44" in Eng. Rm. & Boiler Space
6"x6"x.58" for½L to 50" at Ends in way of ℄ Bhd.
Flat Pl. Keel 47".102" for⅜L & to .72" at Ends
DRAIN WELL
18"x23"
44" Brackets
"A" "B" "C" "D"
7'-10"
5'-10½"
5'-10½"
32'-6"
27'-3"

Ordinary Framing Through Oil Tanks Looking Forward

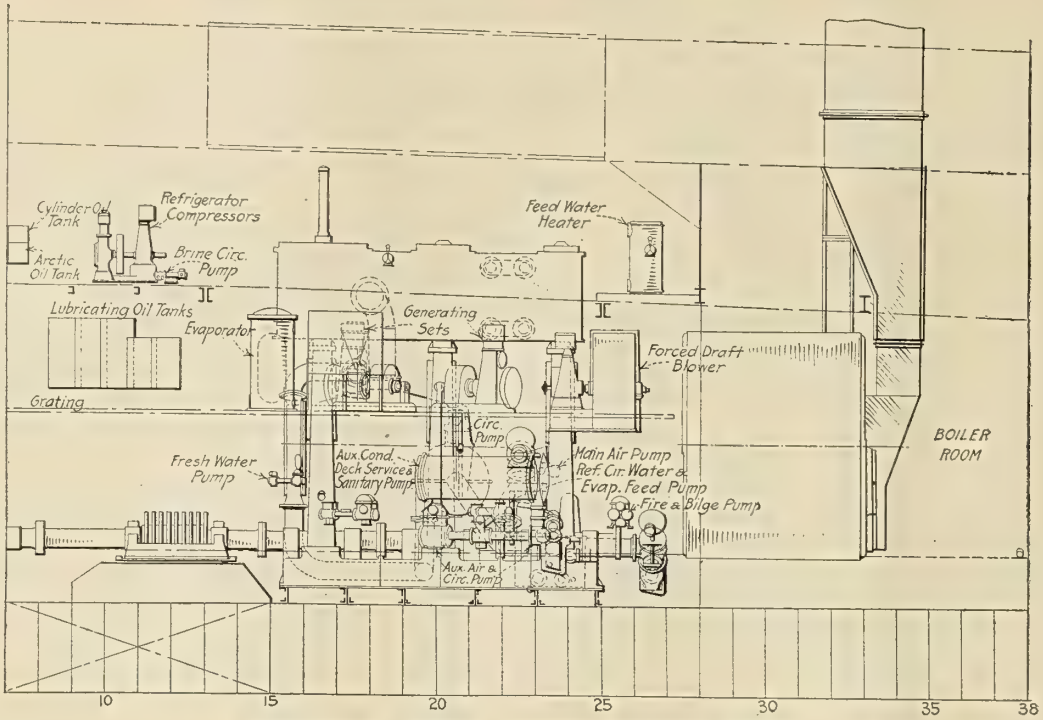
Fig. 4


23"x23"x.42" Bkt's 3½"x3"x.43" Sgl. Ang.
23"x23"x.42" Bkt's 6"x3½"x.38" Sgl. Ang.
3½" Flange
42" Webs in Line with Web Frames and Bhd's. below 33' at Heel and 21' at Head, connected to Shell with 3½"x3½"x.50" Sgl. Ang.
Web Pls. 24"x.40" Fitted on every Web Fr. connected to Expansion Side Plg. with 3½"x3½"x.38" Sgl.
.44" Bkt. Flanged 5"x5"x.43" Sgl. Ang.
3½"x3½"x.38" Sgl. Ang.
5"x5"x.50" Sgl. Ang.
3½"x3½"x.38" Dbl. Ang.
.44" Bkt Flgd.
3½"x3½"x.50" Dbl.
Double Channels 12"x4"x4".70" I on every Web Frame
.50" Gusset
42" Web Pl. on every Web Fr. conn. to Bhd. by 3½"x3½"x.38" Sgl. Attachment Ang.
Face Pl. 45"x12"x.58"
Butt Straps
13'-3½" in Tanks 3-4-5-6-7-8
13'-4½" " " 2-9
Web. Frames and Stringers Pl. 24"x.44" Face Ang. 7"x3½"x.62" Sgl.
Web Fr. Pl. conn. to Shell 5"x5"x.50" Sgl. Ang.
Stringer Pl. conn. to Shell 3½"x3½"x.50" Ang.
Angles Clips conn. Webs to Stringers 5"x5"x.50" Sgl. Ang.
Str. Pl. conn. to Shell for 3 Fr. Spaces each Side of Trans. Bhds. 5"x5"x.50" Sgl. Ang.
4"x6"x.50" Sgl. over Rev. Bars
38" Bracket on one Side of Web conn. to Web & ℄ Bhd by 3½"x3½" 38" Sgl Ang.
3½"x3½"x.50" Sgl.
.50" Guss. Pl.
4"x6"x.50" over Rev. Bars
42" Bracket Flanged
3" Flange
3½" Flange
35"
32'-6"
27'-3"

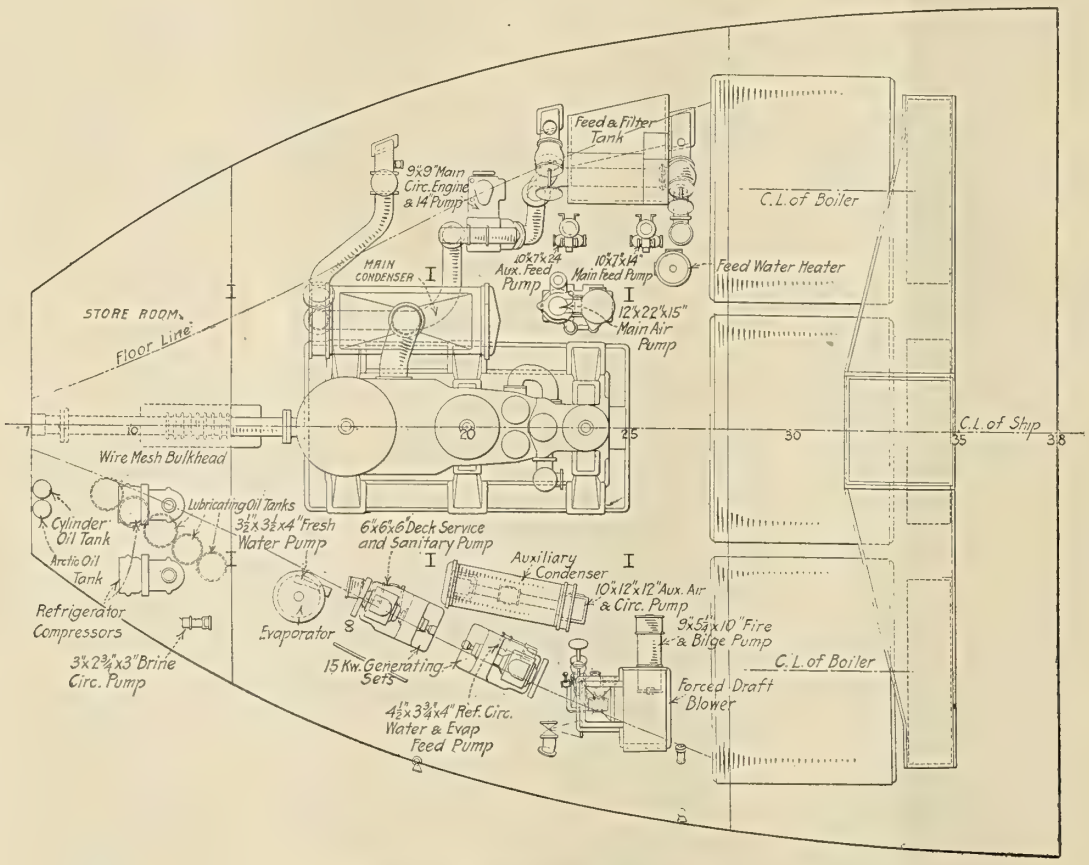
Web Frames through Oil tanks Looking Forward

Fig. 5

MACHINERY ARRANGEMENT, S. S. CUBADIST



Longitudinal Section Through Machinery Space



Plan of Machinery Space

(Figs. 6 and 7)

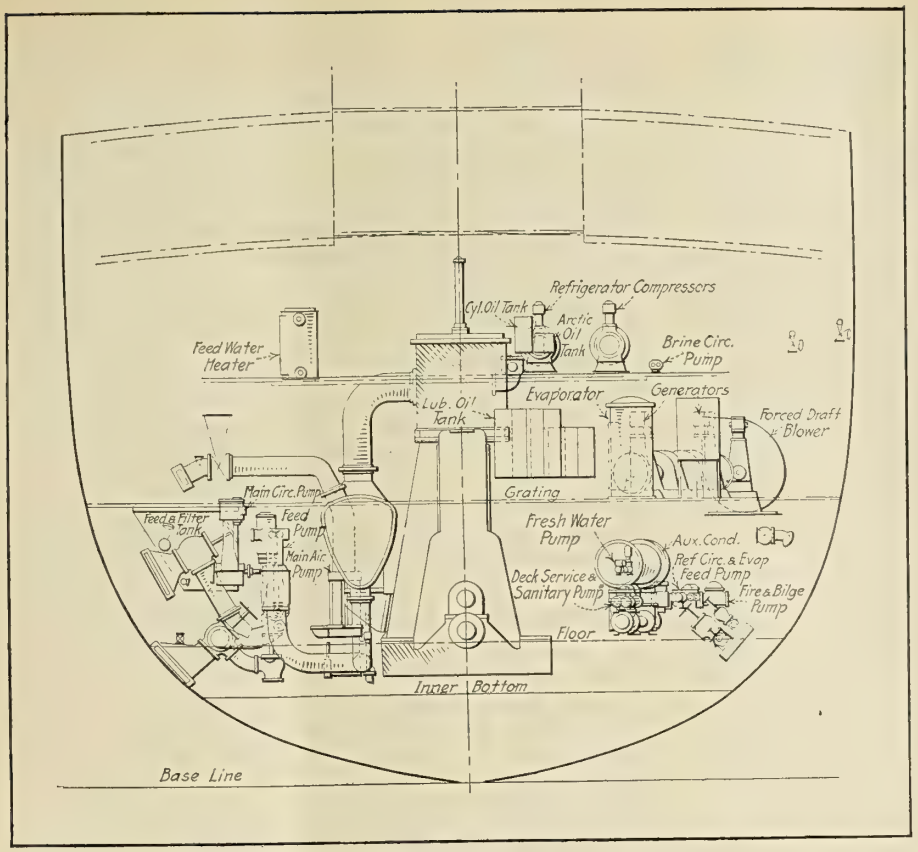


Fig. 8.—Section Through Engine Room of S. S. *Cubadist*

The long poop encloses quarters for the firemen and seamen and in the Liverpool house on the poop deck are arranged the engineers' quarters, with officers' and engineers' mess room, bath and toilet.

The poop deck in way of the deck house is planked with 3-inch by 5-inch Oregon pine having a 10-inch margin plank worked in way of the deck house and waterway. The bridge deck, bridges and housetops are laid with 1¾-inch by 3½-inch T & G yellow pine, covered with canvas. The flats of coal bunkers are laid with two thicknesses of 1½-inch North Carolina pine. The floors in officers' quarters are covered with linoleum. The galley floor is laid with waterproof cement and the bathrooms with ceramic tile. The pilot house and chart room are built of teak.

The joiner work and furniture in the quarters is finished generally in North Carolina pine, except in the saloon and guest room, which is finished in oak. Transoms and seats are upholstered in maroon pantasote.

The sanitary arrangements are very complete, all fixtures being supplied with running water. The salt water is kept under pressure by a salt water sanitary pump, while the fresh water flows by gravity from a daily service tank supplied by the fresh water sanitary pump. The officers' bath and lavatories are supplied with hot as well as cold water.

Cargo Handling Appliances

The vessel is rigged with three pole masts, the fore and main masts being of steel and the mizzen mast of wood. The cargo booms are of wood and consist of two 38-foot booms on the foremast, each of 3-ton capacity, four 50-foot booms on the foremast, two of 3-ton and two of 5-ton capacity. A small boom is provided on the mizzen mast for handling engine room weights and stores.

The method of handling liquid cargo has been designed to meet the special requirements of this trade, and has proven eminently satisfactory under service conditions. The main cargo pump is a horizontal 18-inch by 12-inch by 18-inch duplex Blake pump, located on the port side of the pump room amidships. From this pump a 14-inch suction line is run the whole length of cargo tanks with a 12-inch branch to each tank, port and starboard, with each branch fitted with a gate valve and terminating in a bell mouth, the bottom of which stands within ¾ inch of the bottom of the wells in the double bottom plating previously referred to. The discharge is led through a 10-inch pipe on each side of the vessel, run through the 'tween deck wing compartments, and provided with branches to the main tanks and three overboard discharges above the upper deck, located one just aft of the forecastle enclosure, one just aft of the bridge and one just forward of the poop deck enclosures. This arrangement of piping permits the pump to draw from any one of the eighteen tanks and discharge into any other tank or overboard on either side of ship, forward, aft or midships. There is also provided in the centerline bulkhead and transverse bulkhead of each tank a 12-inch sluice valve, so that cargo may be run by gravity from one tank to the other if so desired. All valves in the cargo holds are operated from above the upper deck.

Pump Room Auxiliaries

In addition to the main cargo pump there is a 16-inch by 10-inch by 18-inch horizontal duplex Blake ballast pump located on the starboard side of the pump room. This pump is arranged either to handle molasses from the main tanks as an auxiliary to the main pump, or to handle the oil cargo in the double bottom tanks independent of the main pump. An independent suction line, both port and starboard of the centerline bulkhead, is led to each double bottom tank and connected to manifolds in the pump room, which are, in turn, connected up to the ballast pump and provided with an emergency connection to the cargo pump.

Geared Turbine

The propelling machinery of the *Sucrosa* consists of a five-stage Curtis turbine driving a single right-handed propeller through a double reduction gear. The turbine is designed to operate at about 3,300 revolutions per minute with boiler steam at a pressure of 190 pounds per square inch. It is of very strong construction and the parts are made of the highest class metal to enable it to operate satisfactorily at these high speeds. The astern turbine is fitted in the same case with the ahead turbine and is designed to give approximately 50 percent of the go-ahead power. The shafting and wheels are made of chrome nickel steel and the blading is of monel metal. The bearings are of the self-adjusting type and the running parts are carefully balanced when running, so that the turbine will operate without vibration. The turbine is coupled to the high speed pinion by means of a flexible coupling.

The gearing consists of two elements—the high-speed gear formed of the single high-speed pinion driving two double helical wheels and arranged so that the high-speed pinion is balanced, the low-speed gear consisting of two pinions driving a single double helical wheel which is bolted to the propeller shaft.

The propeller shaft is arranged to run at 75 revolutions per minute, so that the total reduction from the turbine to the propeller is 30.6 to 1.

The pinions of all the gears are made of chrome nickel steel and the wheels of high carbon steel. The teeth are accurately cut and the parts carefully adjusted so as to insure a uniform transmission of the power over the whole surface of the teeth, and to allow for the necessary self-adjustment between the different parts of the gear. The gears are mounted in a strong cast iron casing with removable bushings lined with white metal and all parts are enclosed, so as to be perfectly oiltight and dustproof. The running parts are supplied with forced lubrication, the delivery and return pipes being of ample size.

Two duplex pumps are supplied for pumping the oil to the bearings and duplex pumps for circulating the water through the oil cooler. The oil cooler is of the Schutte & Koerting type and is of ample capacity, so that the bearings will be kept reasonably cool in any climate. This machinery was manufactured by the General Electric Company at their Schenectady (N. Y.) works.

The propeller is of the built-up type with cast iron hub and four manganese bronze blades with a diameter of 17 feet 6 inches and a designed pitch of 16 feet 3 inches (adjustable). The developed area is 121.5 square feet.

Steam is supplied at a working pressure of 190 pounds per square inch by three cylindrical boilers of the return tube type, each 14 feet 2 inches inside diameter and 11 feet 10 inches long over heads. The boilers have a total heating surface of 7,410 square feet and a grate surface of 165 square feet. They are arranged for burning coal and the furnaces are supplied with heated air. The blowers are arranged in the engine room and the air is brought through trunks over the top of the boilers and through the heating tubes down to the furnace fronts.

Propelling Machinery of the Cubadist

The propelling machinery of the *Cubadist* consists of a single three-cylinder triple expansion reciprocating engine, with cylinders 25 inches, 41 inches and 68 inches diameter by 48 inches stroke, designed to develop 2,100 indicated horsepower at 70 revolutions per minute, with a steam pressure of 185 pounds per square inch. The cylinders are arranged in the following order from forward to aft: high pressure, intermediate pressure and low pressure.

The engine is mounted on a cast iron box type bed plate of three sections and the cylinders are supported by six cast iron columns of box section. Six main bearings for the crankshaft are provided, lined with white metal. The bearing caps are of forged steel and the lower bearings can be removed without disturbing the crankshaft.

The crankshaft is built up of forged steel in three interchangeable reversible sections, with a diameter of 13¾ inches at the bearings. The crankpins are 14 inches diameter by 14 inches long. The crank slabs are 25¾ inches wide by 9½ inches thick. The coupling flanges are 27 inches diameter by 3¼ inches thick. The thrust shaft is 13¾ inches diameter at the ends and 14 5/16 inches diameter at the collars, of which there are nine, each 20½ inches diameter and 1⅞ inches thick. The propeller shaft is 14 13/16 inches diameter, with a composition sleeve fitted complete throughout the length of the shaft. All of the couplings are 26 inches diameter by 3¼ inches thick.

The high pressure cylinder is fitted with a liner and has a piston valve 13 inches diameter, taking steam in the middle and exhausting over the ends. The intermediate pressure cylinder is fitted with two piston valves, each 13 inches diameter, taking steam over the ends, while the low pressure cylinder is fitted with a double-ported slide valve, working on a cast iron false seat. The high pressure and intermediate pressure valves are fitted with balance cylinders and pistons of the ordinary type. The low pressure valve is fitted with a Lovekin patent assistant cylinder and is fitted with a balance ring at the back to relieve the pressure of the valve on its seat. The valve gear is of the Stephenson double-bar type.

The pistons are of cast iron of conical form, fitted with cast iron packing rings and cast iron followers. The piston rods are 6 inches diameter, while the tail rod of the low pressure cylinder is 4 inches diameter. The piston rods and valve rods are fitted with metallic packing. The crossheads are of forged steel and the crosshead slippers of cast iron lined with white metal. The crosshead pins are 7 inches diameter and 7½ inches long, and the connecting rods are of forged steel 9 feet long between centers, the top and bottom end boxes being of cast steel lined with white metal.

The engine is reversed by a direct acting steam cylinder 12 inches diameter by 18 inches stroke, with a 6-inch oil cushioning cylinder secured to the inside of the after back collar. The reverse shaft is 6½ inches diameter carried on the back columns. The turning engine consists of a 6-inch by 6-inch single cylinder at the after end of the main engine.

Condensing Plant

Steam from the low pressure cylinder is exhausted through a copper pipe 21 inches diameter to a Weir type main condenser, carried on cast brackets secured to the two after back columns of the engine. The shell of the condenser is of steel plate with water chests of cast iron and the tube sheets of rolled brass. There are 1,535 ¾-inch outside diameter tubes, No. 17 B. W. G. thick, 10 feet long between tube sheets. The total cooling surface of the condenser is 3,011 square feet.

The main air pump is of Blake & Knowles vertical wet and dry twinplex beam type, 12 inches by 22 inches by 22 inches by 15 inches, with a single steam cylinder. The main circulating pump is of the Fore River centrifugal double suction type with 14-inch suction and discharge connections, driven by a 9-inch by 9-inch engine.

An auxiliary condenser of 800 square feet cooling surface is also provided. The shell is cylindrical and of steel plate, the water chests of composition, and the tube sheets of rolled brass. There are 554 ¾-inch outside diameter No. 17 B. W. G. tubes, 7 feet 4½ inches long between tube sheets. The air and circulating pump is of the horizontal type, 10 inches by 12 inches by 12 inches by 12 inches, located in the engine room and supporting the condenser.

Auxiliary Machinery

Two feed pumps, 10-inch by 7-inch by 24-inch vertical simplex.

One ballast pump, 16-inch by 10-inch by 18-inch horizontal duplex, located in the pump room.

One deck service and sanitary pump, 6-inch by 6-inch by 6-inch horizontal duplex, located in engine room.

One fresh water pump, 3½-inch by 3½-inch by 4-inch horizontal simplex, located in engine room.

One fire and bilge pump, 9-inch by 5¼-inch by 10-inch horizontal duplex, located in engine room.

One brine circulating pump, 3-inch by 2¾-inch by 3-inch horizontal duplex, located in engine room.

One refrigerating circulating water and evaporator feed pump, 4½-inch by 3¾-inch by 4-inch horizontal duplex, located in engine room.

One cargo pump, 18-inch by 12-inch by 18-inch horizontal duplex, located in pump room.

One forward bilge pump, 8-inch by 8-inch by 12-inch horizontal simplex, located on flat above fore peak.

All reciprocating pumps are of the Blake & Knowles Manufacturing Company's make.

Two 2¾-inch Hancock injectors for main boilers.

One injector for hot water to fire main for washing out cargo tanks.

Ash hoist, Crompton type, located on forward bulkhead of fire room. Operating self-dumping buckets in starboard ventilating trunk.

The forced draft blowers, manufactured by the B. F. Sturtevant Company, are located in the engine room at the upper grating level and have a capacity of 24,000 cubic feet of air per minute at 400 revolutions per minute, operating at a reduced steam pressure of 130 pounds per square inch.

The forced draft heaters, which are located in the uptakes at the front of the boilers, consist of 198 tubes for each boiler, 3¼ inches outside diameter, 3 feet 6¼ inches long.

A Reilly feed water heater of the exhaust type is located in the engine room and on the discharge side of the feed pumps. There is also an evaporator of the Griscom-Russell Manufacturing Company's make, of 12 tons capacity per 24 hours, located in the engine room.

The refrigerating plant consists of two Brunswick machines of 2 tons capacity each (in duplicate) and an ice-making tank of 500 pounds capacity in twelve hours.

The electric lighting plant consists of two 15 kilowatt direct connected General Electric Company marine generating sets, with combined generating and distributing switchboard. The distribution is on the two-wire system and supplies current for one 18-inch searchlight and 150 16-candlepower incandescent lamps in addition to running and signal lights. A wireless telegraph outfit is installed in the bridge house.

Lifesaving Equipment

The lifesaving outfit consists of two 24-foot wooden lifeboats, one 16-foot wooden dinghy and one 20-foot wooden gig fitted with a gasoline (petrol) engine. The lifeboats are handled by Martin Freeman compensating davits and the dinghy and gig by bar type davits.

The steering gear is of the Brown steam tiller type, with a 7½-inch by 12-inch engine operated by telemotor from pilot house and the top of the pilot house and by shafting and bevel gears from the top of the poop deck house.

A No. 11 Hyde steam brake windlass is located on the forecastle deck, operated by a worm and spindle from a vertical 12-inch by 12-inch engine on upper deck. Wildcats are provided on the windlass suitable for 2¼-inch diameter stud link anchor chain.

Three Hyde double cylinder, double drum, reversible steam hoisting winches with cylinders 8 inches diameter by 8 inches stroke are located on deck for cargo-handling purposes. Two of these winches are fitted with extended warping ends.

A Hyde special capstan and double-headed gypsy is located aft on poop deck, consisting of a steam-driven capstan driven by an 8-inch by 8-inch engine under the poop deck. This engine is also arranged to drive by shafting, worms and pinions two nigger heads located on the poop deck about 12 feet on each side of the capstan.

On the trial trip of the *Sucrosa,* which took place on June 30, 1916, the machinery operated to the entire satisfaction of the owners' and builders' representatives, and the gears were practically quiet, while the operation of reversing was perfectly easy.

An examination of the gears after the trial showed that the teeth had a good bearing over the whole surface, and the smooth running of the gears and bearings promised a very satisfactory installation.

The *Sucrosa* is a sister ship to the *Cubadist,* which is fitted with reciprocating engines, and the two vessels as regard the hull, propellers, condensing apparatus, boilers and auxiliary machinery, also the method of loading, length of voyage, etc., are identical, so that comparative data between the reciprocating and turbine reduction gear machinery, now being taken by both shipbuilders and owners, should prove of exceptional interest and value.

Large Italian Freighter with Special Equipment for Unloading Cargo

The freight steamer *Milazzo,* built for the Navigazione Generale Italiana by the Fiat-San Giorgio Company, of Muggiano, near Genoa, Italy, arrived in New York on July 1 on her maiden voyage. This vessel is 511 feet 10 inches long overall; 65 feet 7½ inches extreme beam, and 34 feet depth at the side with a load draft of 26 feet. Her displacement at full load is 20,040 tons; gross tonnage 11,477; net tonnage, 7,537, and deadweight capacity,

Italian Freighter *Milazzo*

14,240 tons. She is capable of a speed of 11 knots and is propelled by a single screw driven by a quadruple expansion engine of 4,000 indicated horsepower.

Besides being a cargo carrier of unusual size, special interest in this vessel centers in the arrangements for discarding bulk cargo. Under the main cargo holds, of which there are six, is a double bottom which in section resembles the letter "W." Running beneath the double bottom, midway on each side of the holds, are galleries in which small cars are run on tracks. These cars are automatically loaded by gravity through doors cut in the sloping bottom of the holds over the galleries; then the loaded cars are hoisted through vertical elevating shafts above deck and discharged overside through hoppers and chutes. In all there are twenty of these elevators operated by steam winches. For cargo other than bulk cargo the usual methods of loading and discharging through centerline hatches are employed.

This system of unloading bulk cargo is the invention of Captain C. E. Manada, and elevators of the Menada type have previously been installed on lighters in Italian and South American ports.

TANK STEAMER EQUIPPED WITH WESTINGHOUSE GEARED TURBINES

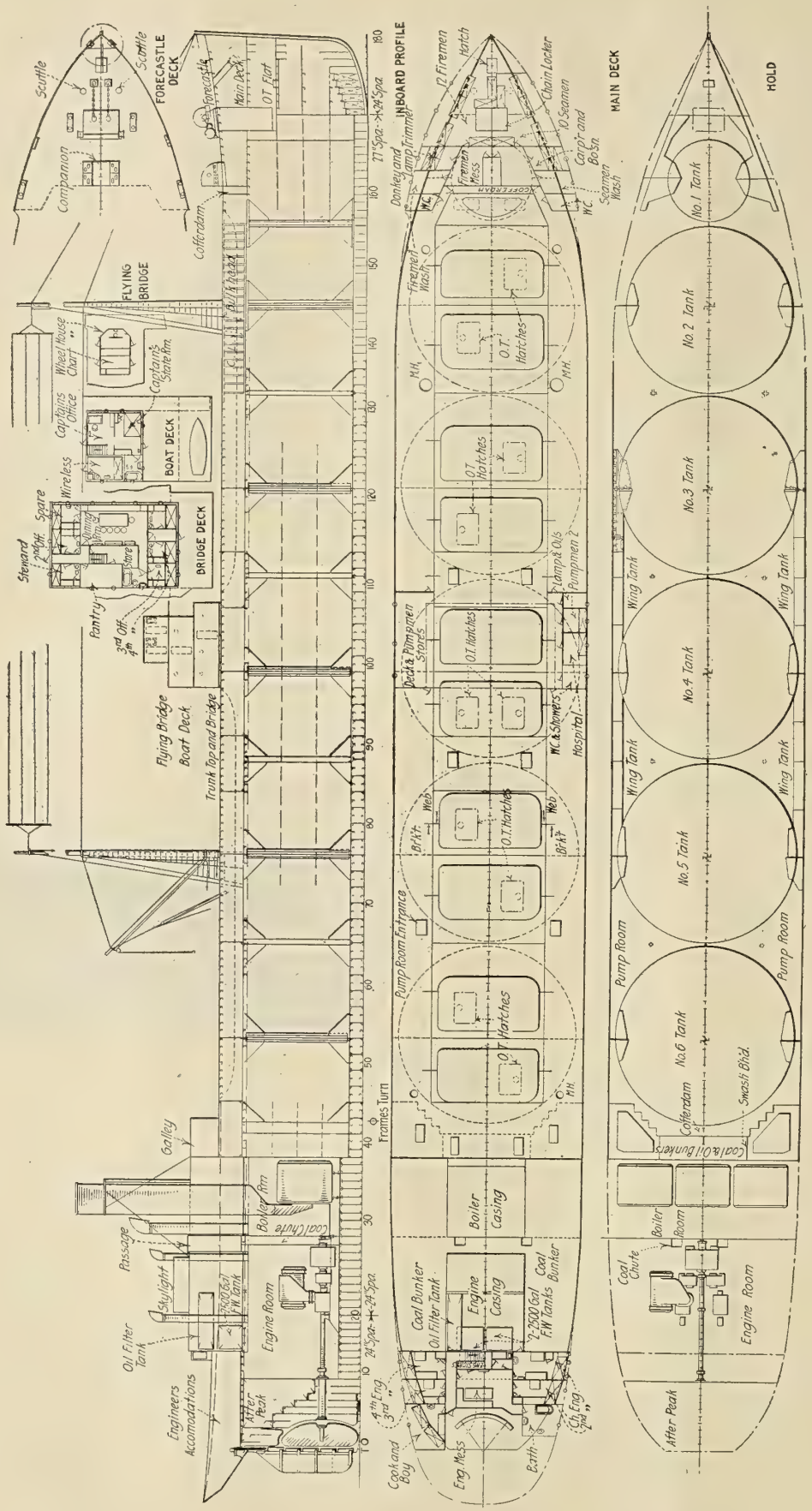


Fig. 1.—Inboard Profile and Deck Plans

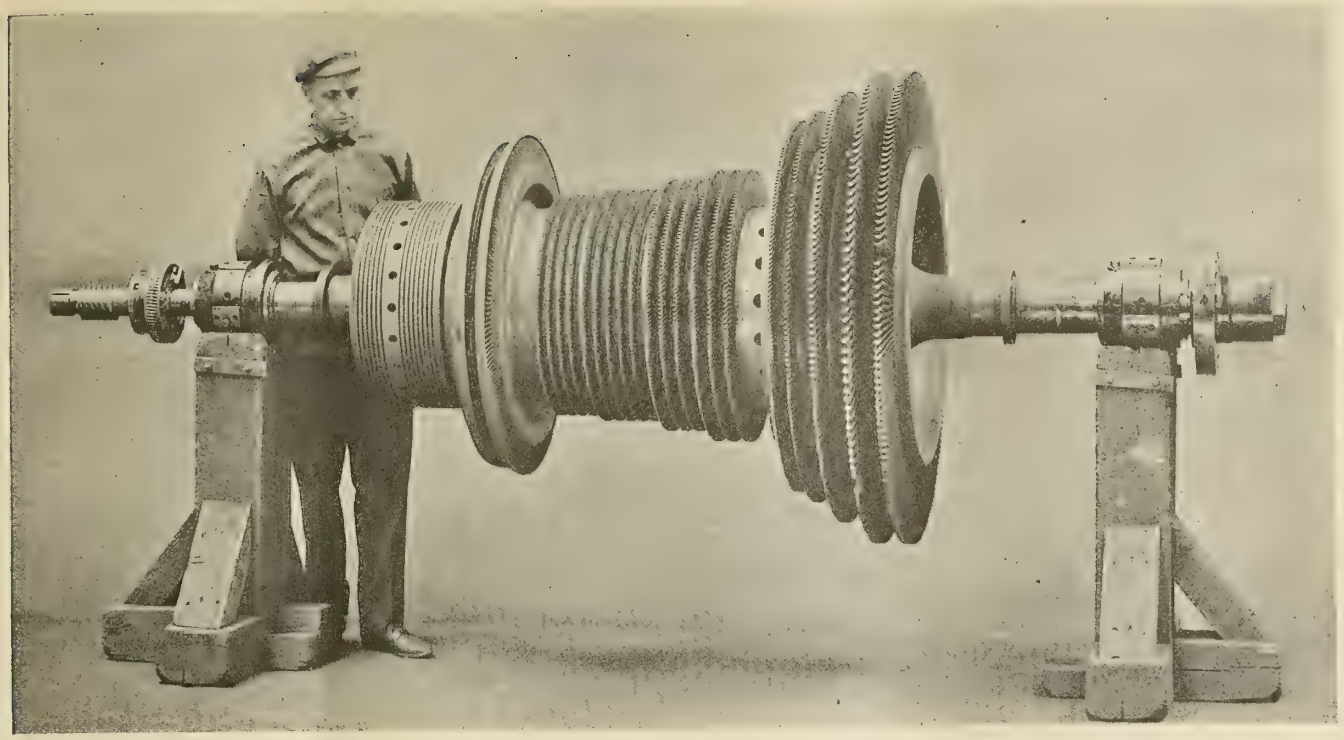


Fig. 2.—Impulse Reaction Turbine Spindle showing Blading, Dummy, Main Bearings, Thrust Bearing, Governor Drive Gear and Flexible Coupling

Westinghouse Geared Turbine Machinery for Single Screw Tank Steamer

Cross Compound, Double Reduction Type Turbine Drive—Entire Equipment of Main and Auxiliary Machinery of the Rotary Type

FOURTEEN large tank and freight steamers which represent the latest developments in machinery and hull construction, are unter construction at the yards of the Chester Shipbuilding Company, Chester, Pa. One of these vessels, described below, is of the following dimensions:

Length	401 feet
Beam	54 feet
Draft	25 feet 9 inches
Displacement	12,650 tons
Cargo capacity	9,000 tons

The vessel is designed to carry oil. The main tanks are cylindrical and between them and the ship's side are formed the wing tanks as shown in Fig. 1. By this construction the bulkheads are cylindrical in form and hence the surface subjected to liquid pressure is concave, which gives greater strength for the same weight. The use of this construction permits considerable reduction in the weight of the bulkhead structures.

The propelling machinery is located in the stern and consists of three single-end Scotch boilers and geared turbines for driving the single propeller. The boilers are equipped with forced draft and have a heating surface of 8,860 square feet.

Propelling Machinery

The propelling machinery is to be supplied by the Westinghouse Machine Company, of East Pittsburgh, Pa., and will be of their geared turbine type, arranged as shown in Fig. 3. The unit, which is of the cross compound, double reduction type, is composed of a high and a low pressure turbine, two single pinion first reduction gears and one double pinion second reduction gear.

The ahead high pressure turbine is composed of a two row impulse wheel followed by reaction blading on a drum. The ahead low pressure turbine is of the reaction type. The astern high pressure and low pressure turbines are two row impulse wheels. In both ahead and astern turbines the steam passes successively through the high and low pressure turbines.

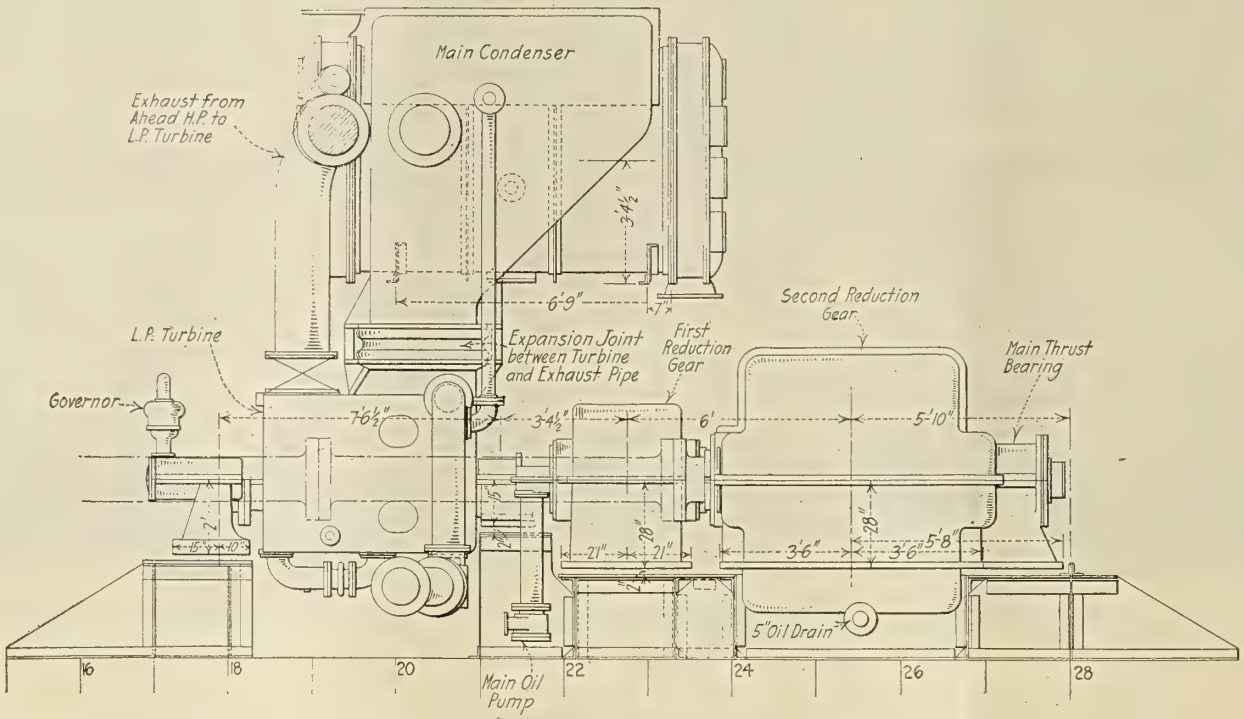
The reduction gears are of the double helical floating frame type. The first gears are provided with hydraulic dynamometers for the measurement of power and drive rotary oil pumps which supply lubricating oil to the unit. A Kingsbury main thrust bearing is contained in the forward end of the second gear.

The admission of steam to the ahead and astern turbines is controlled by two balanced throttle valves, both of which are contained in one body and operated by the same hand wheel. The piping and valves are arranged so that in addition to the normal cross compound operation, either the high pressure or the low pressure ahead or astern turbines can be operated independently in case of emergency, the turbines being controlled by the main throttle valves in all cases.

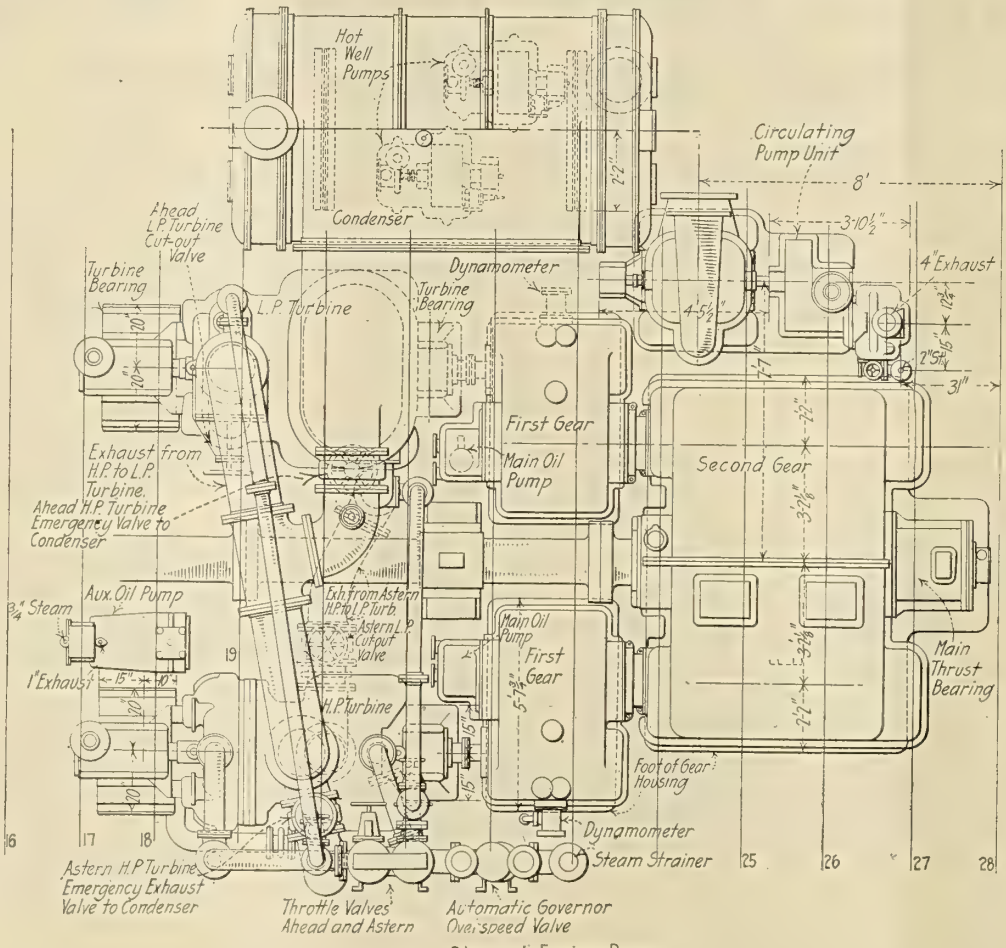
The condensing plant, which is designed for high vacuum, is composed of a steel plate surface condenser, a geared turbine driven centrifugal circulating pump, two

ARRANGEMENT OF PROPELLING MACHINERY

(Fig. 3)



Elevation Looking to Port



Plan of Engine Room

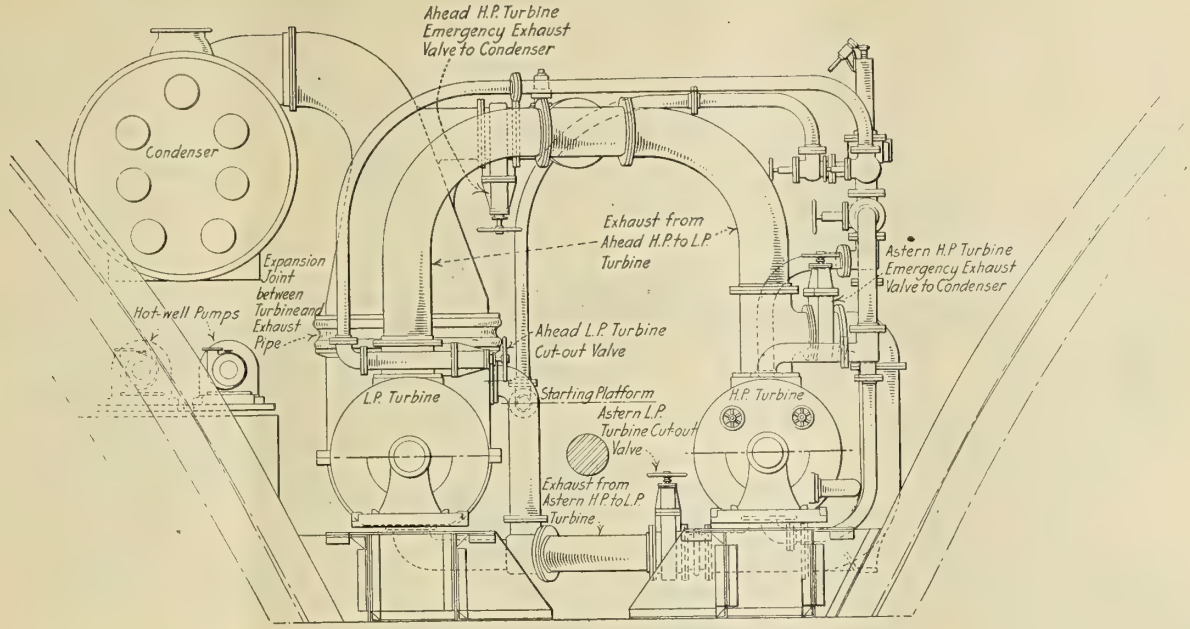

Ahead H.P. Turbine Emergency Exhaust Valve to Condenser
Condenser
Exhaust from Ahead H.P. to L.P. Turbine
Astern H.P. Turbine Emergency Exhaust Valve to Condenser
Expansion Joint between Turbine and Exhaust Pipe
Hot-well Pumps
Ahead L.P. Turbine Cut-out Valve
L.P. Turbine
Starting Platform
H.P. Turbine
Astern L.P. Turbine Cut-out Valve
Exhaust from Astern H.P. to L.P. Turbine

Fig. 4.—Cross-Section Through Engine Room

turbine driven centrifugal hot well pumps, and two Leblanc air ejectors.

The lubrication of the main turbine bearings, the gear teeth and bearings is effected by a continuous circulation of oil through a gravity system composed of delivery and return piping, pumps, cooler, strainer and tank.

The turbine and gear foundations are of the usual plate and angle construction built up from the engine room floor as shown.

The ship is designed for a normal speed of 10¾ knots and for a maximum of 11½ knots, on a displacement of 12,650 tons, the designed performance data being as follows:

Speed, knots	10.75	11.5
Revolutions per minute, propeller	70	75
Revolutions per minute, turbine	3,600	3,860
Shaft horsepower	2,500	2,900
Shaft horsepower, astern	1,500	1,740

The astern turbines will develop 60 percent of the ahead power with the same flow of steam. Steam will be supplied to the turbines at a pressure of 180 pounds gage, and the condensing plant is designed to maintain a vacuum of 28½ inches of mercury.

The machinery weights are as follows:

Turbines, steam piping and valves	17.9 tons
Gears, thrust bearings and oil pumps	34.0 tons
Condenser	11.6 tons
Condenser auxiliaries	3.6 tons
Oil system	1.6 tons
Total	68.7 tons
Total	61.5 pounds per shaft horsepower

Turbines

The turbines are of the Westinghouse impulse reaction cross compound type, as illustrated in Figs. 5 and 6. At full power the turbines are designed to develop 1,250 horsepower each, or a total of 2,500 horsepower at a speed of 3,600 revolutions per minute.

The turbine cylinders are made of cast iron, except the ahead end of the high pressure turbine, which is of cast steel, and are divided on the horizontal plane. The main bearing pedestals at the exhaust ends are cast integral with the lower halves, while at the inlet ends the main and thrust bearing pedestals, which also carry the governors, are cast separately and bolted on. Feet are cast on the exhaust end of the cylinder, and at this end the cylinder is bolted to the foundations. At the forward end the bearing pedestal is supported on a cast steel sole plate which is bolted to the foundations. Slides are bolted to this sole plate to allow the freedom for expansion of the turbine cylinder in a fore and aft direction.

The ahead high pressure nozzle chamber is contained in the end of the cylinder casting, which is made of cast steel to withstand the high pressure and temperature. The astern high pressure nozzle chamber is a separate steel casting bolted inside of the cylinder. The astern low pressure nozzle chamber is of the same construction, but is made of cast iron. The ahead low pressure nozzle chamber is formed in the cylinder as shown. The nozzle chambers in the upper and lower parts of the cylinder (except the ahead low pressure) are separate, each being provided with its own inlet and steam pipe.

The shafts and rotors are made of forged steel. The impulse wheels are formed integral with the shafts and the parts of the rotor are bolted together on a large diameter. The length between bearings is made short and the construction exceedingly stiff to obtain smooth and safe operation.

The high pressure ahead and astern and the low pressure astern nozzles, which are of the divergent type, are cast in bronze and secured to the nozzle chambers as shown. The upper high pressure ahead nozzle chamber is divided into three compartments, two of which are provided with hand operated valves for closing off part of the nozzles at reduced power. With this arrangement of group control, all, five-sixths or three-fourths of the nozzles can be in operation as required. The astern nozzles are not arranged for group control because economy at reduced astern power is of little importance.

LONGITUDINAL SECTIONS OF MAIN TURBINES

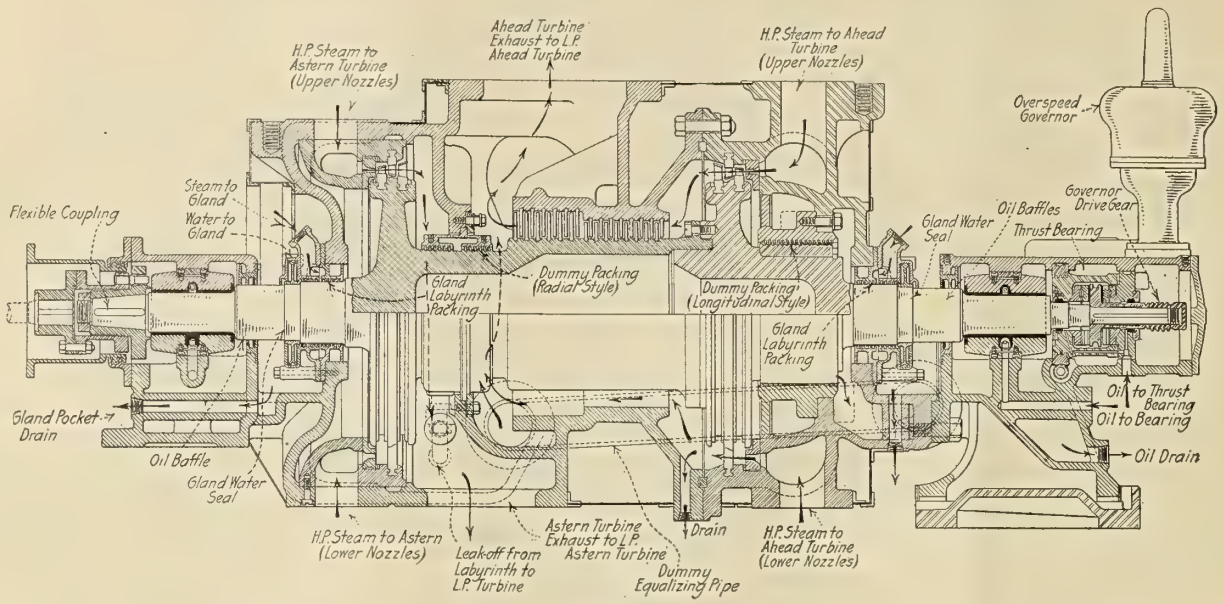


Fig. 5.—High Pressure Turbine

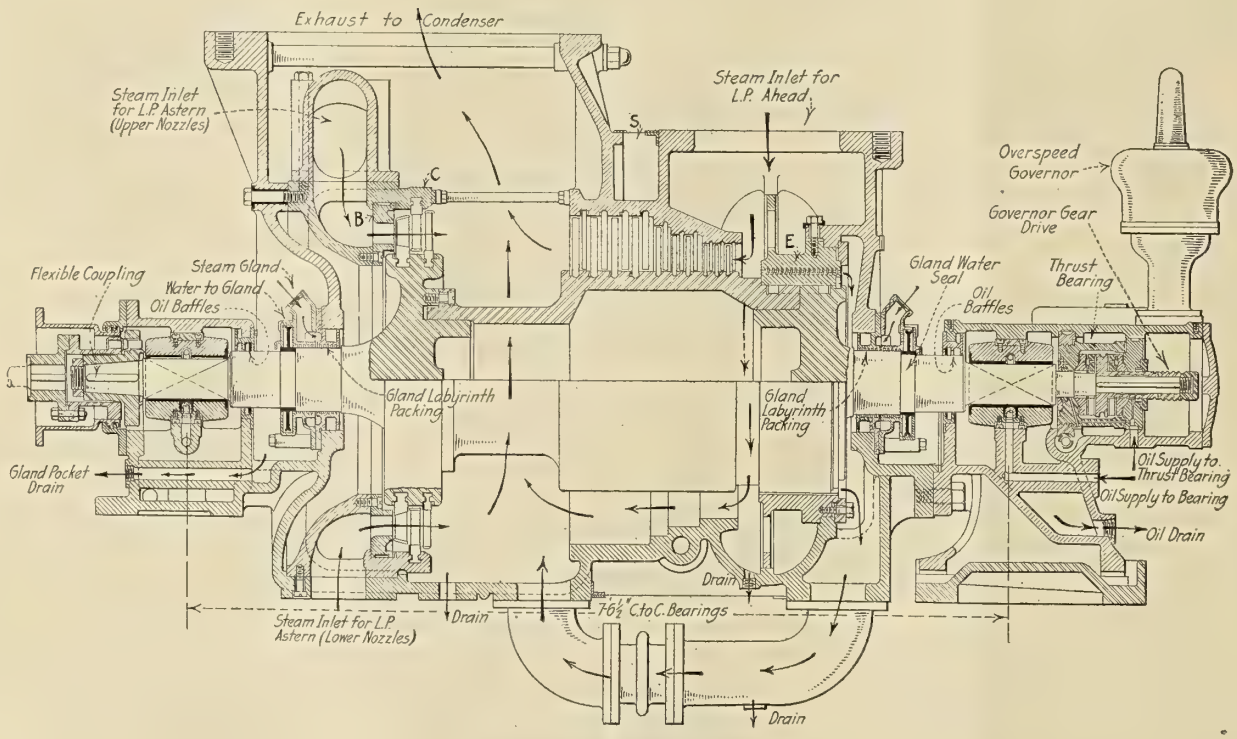


Fig. 6.—Low Pressure Turbine

BLADING

The impulse blades are made of machined nickel steel. They are secured in the rotor by a tongue and groove construction, and also are additionally secured against vibration by being tightly wedged in the groove. The tips of the blades are secured by a binding strip which is inserted in a groove and welded. This construction is unusually strong and rigid.

The reaction blading is made from drawn phosphor bronze. As shown in Fig. 7, the foot which is formed on the end of the blade fits under the packing piece, forming a positive interlock which holds the blade securely. The blade groove is under cut and provided with a groove in the floor of the main groove for the reception of the feet of the blades. The blades are secured at their outer radius by a comma lashing wire which is passed through them near the ends, sheared and clinched and silver soldered. An important feature in this blading construction

is that the blade section is tapered, being thicker at the root than at the tip for the purpose of equalizing the stresses.

Balance pistons are located at the inlet ends of the ahead high pressure and low pressure turbines to balance partially the steam thrust on the drums. The stationary part, which carries aluminum strips, is made in halves and bolted to the cylinder as shown. Balance pipes connect the spaces behind the dummies with the exhaust from their reaction blading.

Labyrinth Packing

A packing of the radial labyrinth type is located between the high pressure ahead and astern turbines. The stationary part is made of bronze and held in the partition by a spring ring as shown. The packing strips are made of special composition, and are held out against shoulders in their grooves by flat springs. Between the strips there are baffles on the rotor to interrupt the flow. An annular leak off chamber which is connected with the last expansion of the low pressure turbine is provided to utilize part of the leakage from the exhaust chamber.

The glands are composed of steam sealed labyrinths and water seals. The labyrinth is of the radial type, the strips being held out against shoulders in the groove by flat springs. The steam gland is sealed from an annular chamber and port as shown. The water seal operates on the principle of a centrifugal pump. The impeller is provided with radial paddles or ribs, and revolves in a chamber which is supplied with water at the periphery of the impeller. The centrifugal action of the paddles on the water causes it to revolve and to form a ring of water under considerable pressure in the chamber, which gives a perfect seal against passage of air into or steam out of the turbine. The water seal is designed to operate from full to half speed. Below the latter speed the centrifugal force is not sufficient to maintain the seal, and therefore, from stop to half speed, it is necessary to use the steam sealed labyrinth. The steam seal will, therefore, be used when steaming at very low speed, maneuvering and standing by.

Steam is supplied to the glands from the main steam line through a reducing valve which regulates the pressure to about 5 pounds gage, as shown in the diagram Fig. 9. Water is supplied to the glands from a gravity tank into which the discharge of the condensate pump is led before passing to the feed tank, as shown in Fig. 10. The tank is located about 12 feet above the glands, which gives a pressure of about 5 pounds. The steam and water to the glands are led through valves which are operated by the maneuvering valves so that the water is shut off and the steam turned on automatically in case the turbines are slowed down suddenly.

The main bearings are of the self-alining type and are provided with pads and liners, by means of which the rotor can be adjusted vertically and horizontally. The body is made of cast iron and the lining of white metal. Oil is supplied through the bottom pad and is led up to a distributing groove in the top of the bearing. Felt wipers are provided around the shaft to exclude dirt.

The thrust bearing is of the Kingsbury segmental type, and is provided with means for moving the rotor endwise for adjusting the dummy clearances. This is accomplished by a nut which works on threads on the body of the bearing and is revolved in a groove in the turbine casing by a hand-operated worm, which is turned by a hand wheel.

Oil from the supply piping is supplied to the bearings at a pressure of about 5 pounds through the channels shown, and after having passed through the bearings, it drains into the wells, and thence passes into the drain piping.

The turbine shaft is connected to the flexible shaft of the pinion by means of a pin coupling which permits the pinion to move endwise. Provision is made for lubricating the pins and bushings.

An emergency overspeed governor is located forward of the thrust bearing, and is driven from the turbine shaft by spiral gears at 24 percent of the speed of the turbine, or at 857 revolutions per minute for the full speed. The governor is of the centrifugal type and controls the governor valve in the main steam line by means of a steam relay. The floating lever and pilot valve are located on the governor. Steam from the pilot valve is piped to the relay cylinder which operates the governor valve, and the motion of the latter is transmitted back to the floating lever through shafts and rods.

The hot portions of the turbine cylinders are lagged with non-conducting material, and the middle portion of

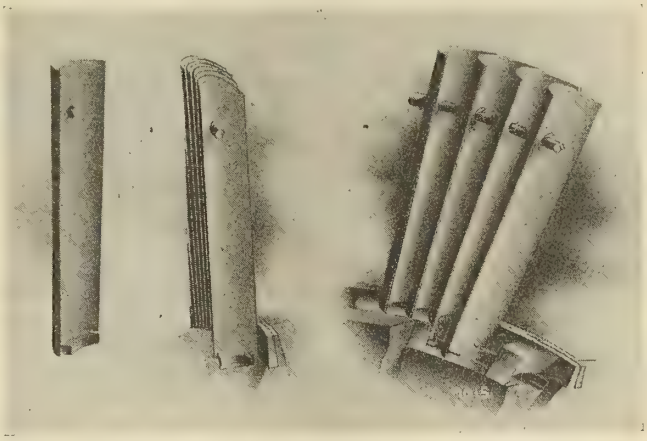


Fig. 7.—Construction of Reaction Blading, showing Hook at Base of Blade, Wedges and Comma Lashing

the cylinder is enclosed in a 1/16 inch sheet metal jacket, which is arranged for removal and for access to the turbine joints.

All pockets in the turbines and piping are provided with drains, which are led into a steam ejector which discharges the water into the condenser as the latter is located several feet above the drain levels. Relief valves are located on the ahead and astern receiver pipes.

The lifting gear is composed of I-beam girders and chain hoists above the turbines and gears, and special slings and guides are provided for lifting the rotors without injury to the blading. A hand ratchet lever which operates on ratchet teeth cut on the flange of the coupling is provided for turning the turbine.

All pipe connections to the turbines are designed to allow free expansion without imposing stress on the turbine cylinders. The turbine will be tested to 20 percent above the designed full speed, or to 4,320 revolutions per minute.

Turbine Valve Gear and Steam Piping

The arrangement of the turbine steam valves and piping is shown in Fig. 3, and diagrammatically in Fig. 8. Fig. 11 shows the valve group, which is composed of a steam strainer, governor valve and ahead and astern maneuvering valves.

The steam strainer has a cast iron body and perforated steel cylindrical strainer.

The governor valve is of the double disk balanced type

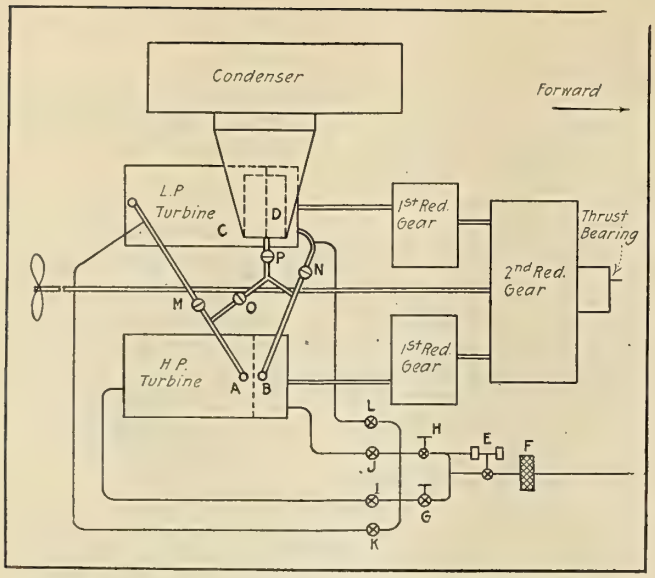


Fig. 8.—Diagram showing Steam Piping and Valves of Main Turbines

A, high pressure ahead turbine; *B*, high pressure astern turbine; *C*, low pressure ahead turbine; *D*, low pressure astern turbine; *E*, automatic governor overspeed valve; *F*, steam strainer; *G*, ahead throttle valve; *H*, astern throttle vale; *I*, high pressure ahead turbine cut-out valve; *J*, high pressure astern turbine cut-out valve; *K*, emergency steam valve to ahead low pressure turbine; *L*, emergency steam valve to astern low pressure turbine; *M*, ahead low pressure turbine cut-out valve; *N*, astern low pressure turbine cut-out valve; *O*, ahead high pressure turbine emergency exhaust valve to condenser; *P*, astern high pressure turbine emergency exhaust valve to condenser.

operated by two steam relay pistons through a yoke. The operation of the relay pistons and the opening and the closing of the valve are controlled by the turbine governors and pilot valves as previously described. The high pressure turbine governor controls one of the relay cylinders and the lower pressure governor the other. The operation of either cylinder will close the valve. Under normal operating conditions the governor weights are held in against their stops and the valve is wide open. Should the speed of either turbine element reach the overspeed for which the governor is set, the weights move out and cause the valve to close sufficiently to prevent further increase in speed. With this arrangement, the turbine is not shut down completely and is always under direct control of the maneuvering valves.

The ahead and astern maneuvering valves are contained in a single cast steel body, and are of the balanced single disk type with a pilot valve on the valve stem for automatically equalizing the pressure in opening. Springs are provided above the valves to prevent them from chattering in the current of steam. The valves, balance cylinders and pilot valves are of bronze. Both valves are operated by a single hand wheel which operates through shafts, bevel gears and a screw, the yoke which lifts the valves against the compressions of their springs are shown. In the stop position both pilot valves are held closed by their springs, and the main valves by the unbalanced pressures above the pistons. The automatic valves for the gland sealing steam and water are operated by cams attached to the yoke as shown.

The main high pressure steam piping is of steel, and the low pressure receiver piping between the turbines and the main exhaust pipe is of cast iron. A copper expansion joint is located between the turbine and exhaust pipe, and another in the astern receiver pipe.

Reduction Gears

The reduction gears are of the Westinghouse mechanical floating frame type as shown in Figs. 12 and 14. At

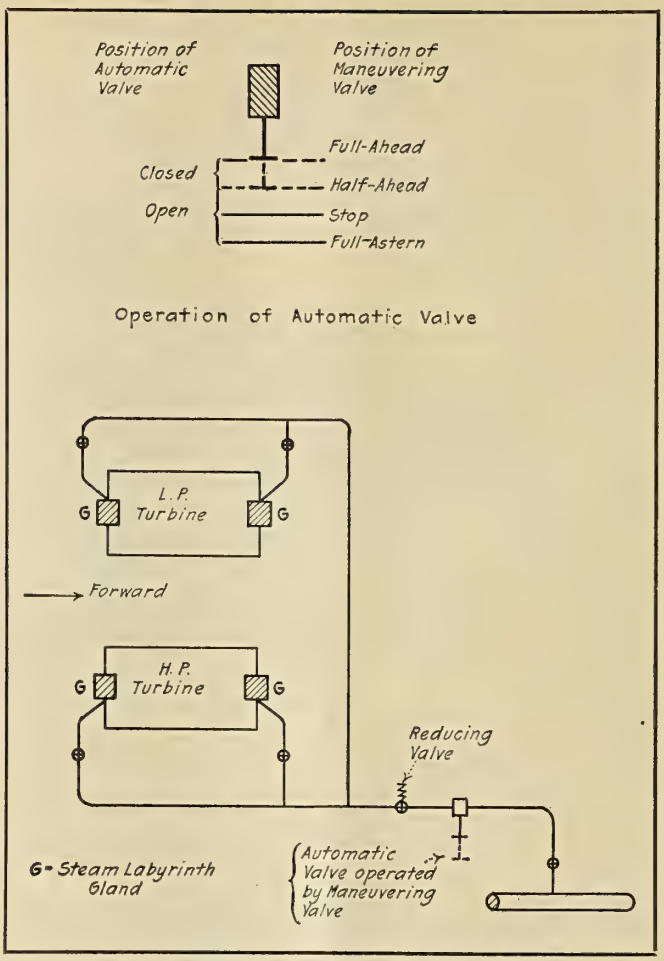


Fig. 9.—Diagram of Turbine Steam Seal Piping

the designed full power, the first or high speed gears reduce the speed from 3,600 to 450 revolutions per minute, the ratio being 8 to 1, and transmit 1,250 horsepower each. The second or low speed gears reduce the speed from 450 to 70, the ratio being 6.45 to 1, and transmit 1,250 horsepower per pinion, or a total of 2,500 horsepower. The total speed reduction from the turbine speed of 3,600 to the propeller speed of 70 gives a ratio of 51.4 to 1.

The gears are completely enclosed in an oil-tight cast iron gear box, divided on a horizontal plane. The gears are of the double helical type, the teeth being inclined at an angle of 30 degrees. The teeth are of involute form

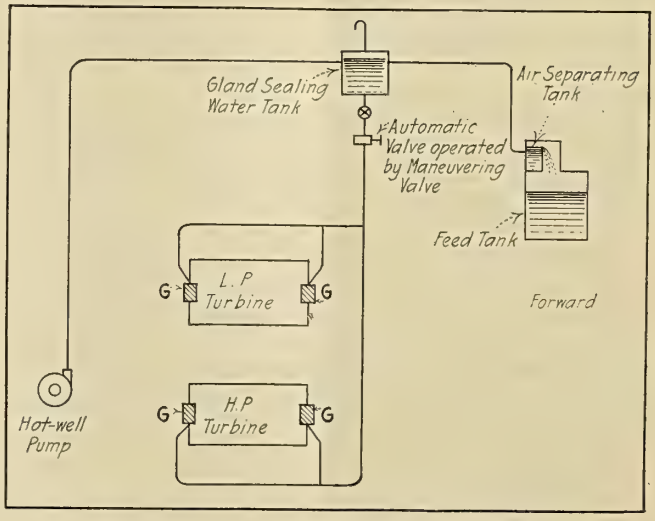


Fig. 10.—Diagram of Turbine Water Seal Piping

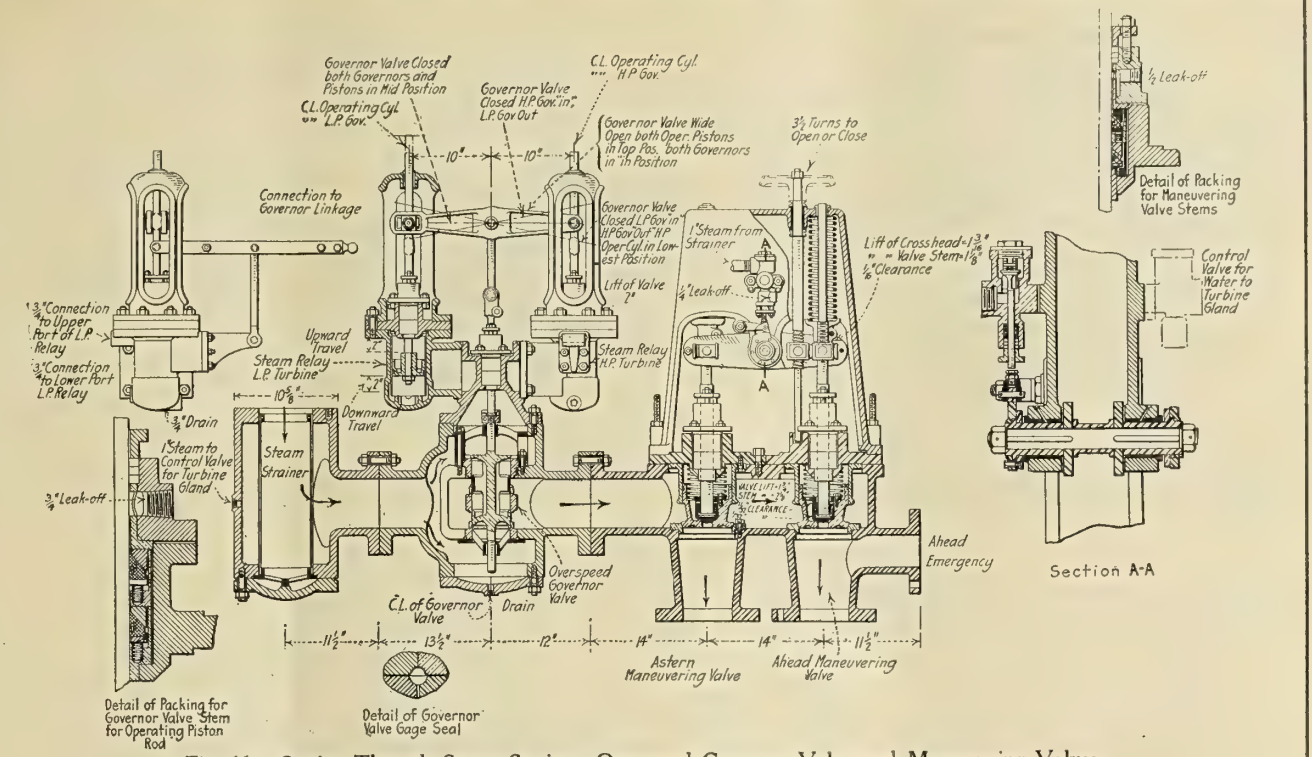

Governor Valve Closed both Governors and Pistons in Mid Position
C.L. Operating Cyl. L.P. Gov.
C.L. Operating Cyl. H.P. Gov.
Governor Valve Closed H.P. Gov. In, L.P. Gov Out
Governor Valve Wide Open both Oper. Pistons in Top Pos. both Governors in in Position
3½ Turns to Open or Close
½ Leak-off
Detail of Packing for Maneuvering Valve Stems
Connection to Governor Linkage
Governor Valve Closed L.P. Gov in H.P. Gov Out H.P. Oper. Cyl. in Lowest Position
1" Steam from Strainer
Lift of Valve 2"
¼" Leak-off
Lift of Cross-head = Valve Stem 1⅛" ⅛" Clearance
Control Valve for Water to Turbine Gland
¾" Connection to Upper Port of L.P. Relay
¾" Connection to Lower Port L.P. Relay
Upward Travel
Steam Relay L.P. Turbine
Steam Relay H.P. Turbine
Downward Travel
¾" Drain
1" Steam to Control Valve for Turbine Gland
Steam Strainer
¾" Leak-off
Ahead
Emergency
Section A-A
C.L. of Governor Valve
Drain
Overspeed Governor Valve
Astern Maneuvering Valve
Ahead Maneuvering Valve
Detail of Packing for Governor Valve Stem for Operating Piston Rod
Detail of Governor Valve Gage Seat

Fig. 11.—Section Through Steam Strainer, Overspeed Governor Valve and Maneuvering Valves

and are cut with utmost precision to obtain reliable and quiet operation.

The pinion is of the three bearing type and is carried in a heavy floating frame, which automatically maintains the alinement of the pinion and gear under all conditions of load, thereby producing uniform distribution of the pressure over the entire length of tooth face. The pinion is driven by a flexible shaft which extends through it and is secured to the end distant from the coupling. The flexible coupling permits the pinion to move endwise, and the flexible shaft permits it to tilt under the action of the teeth, bringing it into perfect alinement, thereby distributing the load across the entire length of tooth face. The uniform distribution of pressure at all loads permits the use of higher pressures and smaller pinions and gears than is the practice with rigid bearing gears.

The floating frames, which are of extremely rigid construction to avoid deflection, are supported by feet under the middle bearing. The support is sufficiently flexible to permit the required tilting in the vertical plane. The ends of the floating frame are held in the correct vertical plane (i. e., the pinion is held in the correct alinement with the gear horizontally) by horizontal struts or guides. The frames are divided and bolted together horizontally, a longitudinal channel for supplying oil to the pinion bearings and teeth being formed in the joint. The frames of the first gears are made of cast iron, and those of the second gear of cast steel.

The gear wheels are composed of a heavy forged steel shaft, a cast iron center and forged steel rims.

The gear and pinion bearings are composed of heavy cast iron bodies lined with white metal. The bearings are supplied with oil from longitudinal channels on the sides which are supplied from the channels shown. Oil under a pressure of about 5 pounds is supplied to the gear from the oil system. No oil piping or fittings are contained in the gear box. A trough which is supplied with oil from the channel in the floating frame, is provided for supplying oil to the teeth from above as shown. Oil is supplied to the teeth from below by sprays which are directed against the back of the pinion from the channel in the frame, the oil being carried around with the pinion and drawn in through the meshing teeth.

Hydraulic Dynamometers

Westinghouse hydraulic dynamometers for measuring the power transmitted are incorporated in the pinion frames of the first gear. The dynamometer is composed of two pistons, one above and one below, which seat on the gear box and operate in cylinders in the floating frame. Normally the feet of the frame are bolted securely to the gear box with long bolts which extend up through the cover, but when it is desired to measure the power these bolts are unscrewed sufficiently to permit the frame to float on the hydraulic pistons.

The hand control valve on the control arm of the frame is then opened, permitting oil to flow from the bearing into the cylinder, until the frame is raised from its seating slightly, which is indicated by the pointer on the control arm. (The pinion journal acts as a pump and supplies a considerable flow of oil under high pressure.) Since the frame is then supported by the oil pressure, the total pressure on the piston, corrected for the weight of the pinion and floating frame, represents the total pressure on the teeth, and this combined with the pitch line speed gives the horsepower transmitted by the gear. Or actually the gage pressure of the oil in the dynamometer cylinder, and the revolutions per minute, are observed, and after correcting the former, the power is obtained from their product multiplied by a constant. The sum of the power of both gears gives the total power transmitted to the propeller.*

* See footnote on page 374.

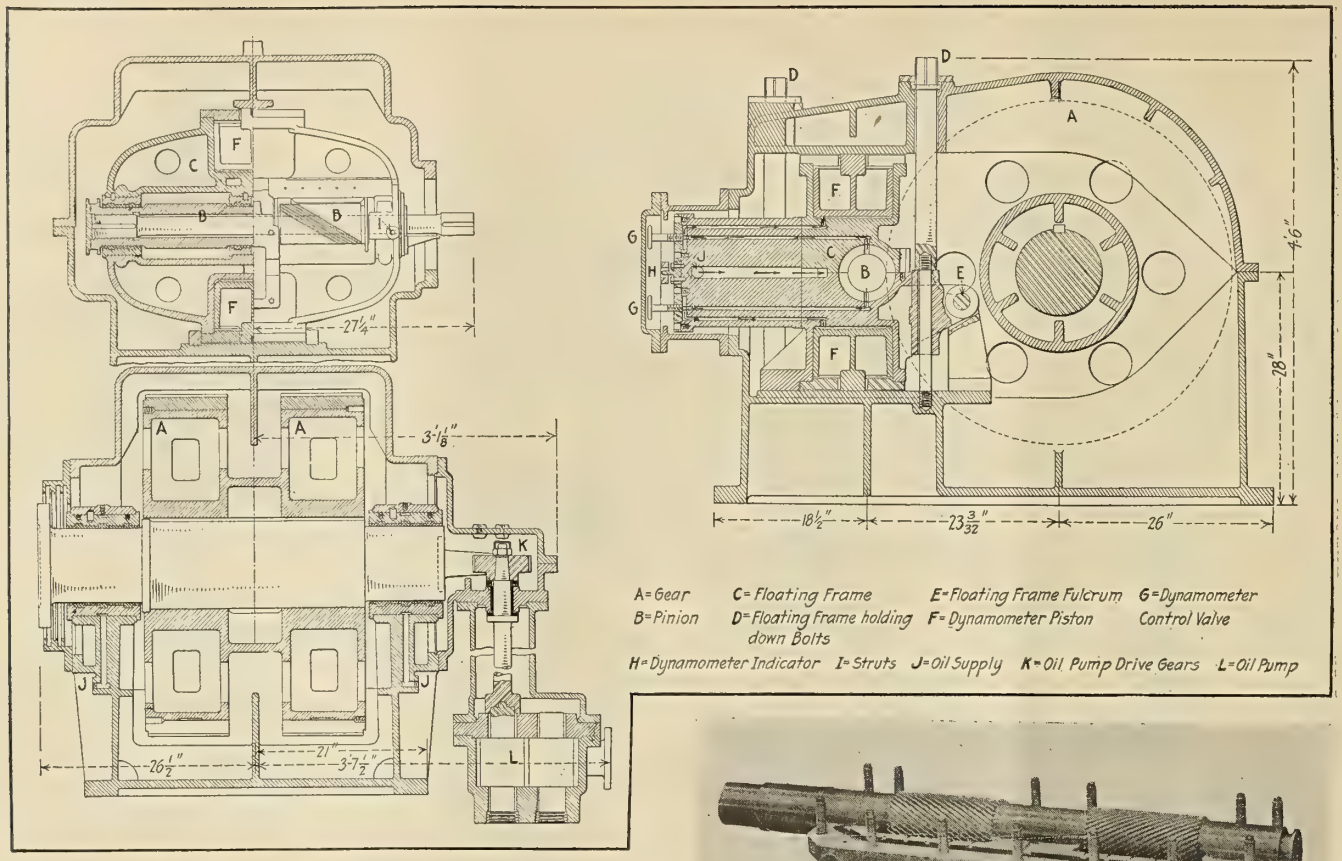


Fig. 12.—First Reduction Gear

KINGSBURY THRUST BEARING

A Kingsbury thrust bearing which takes the thrust of the propeller is located on the forward end of the second gear, as shown in Fig. 14. Since the thrust is transmitted to the ship's structure through the gear box, the necessity for an independent thrust block foundation is obviated. The bearing has a single collar which is secured to the gear shaft and revolves between two sets of segmental slippers. Each slipper is pivoted on a hardened seat which permits it to automatically assume the required position to distribute the load uniformly over the surface. The slippers are carried in a slipper ring with a spherical seat which permits the ring to assume the position required to distribute the load equally among the slippers. This uniform distribution of pressure over the entire bearing surface and the self-alinement of the slippers give perfect film lubrication, which permits the use of a considerably higher unit pressure than is used in ordinary thrust bearings, and also gives greater reliability of operation.

*

$$\text{S. H. P.} = \frac{P_t V}{33{,}000}, \text{ where}$$

$$P_t = A\,p = \frac{\pi}{4} d_c^2\, p \quad \text{and}$$

$$V = \frac{\pi\, d_D\, n}{12} = \frac{\pi\, d_D\, N\, R}{12}$$

$$\text{S. H. P.} = \frac{\pi^2\, d_c^2\, d_D\, R\, p\, N}{4 \times 12}$$

$$\text{But } \frac{\pi^2\, d_c^2\, d_D\, R}{48} = \text{Constant} = C.$$

$$\text{Hence S. H. P.} = C\, p\, N,$$

where P_t = total pressure between the teeth in pounds.
V = pitch line speed in feet per minute.
A = area of piston in square inches.
p = pressure on piston in pounds per square inch.
d_c = diameter of cylinder in inches.
d_D = diameter of pinion in inches.
n = revolutions per minute of pinion.
N = revolutions per minute of propeller.
R = reduction ratio.

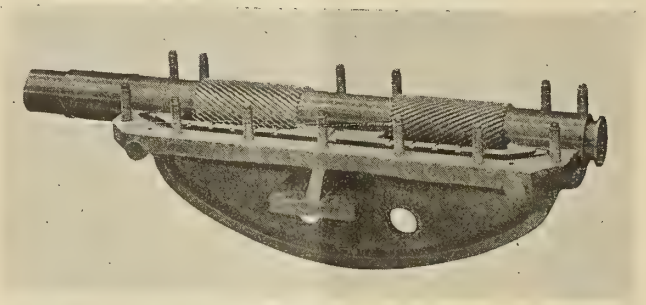


Fig. 13.—View of Pinion resting in Floating Frame, showing Bearings and Oil Supply Grooves to Pinion and Bearings. (Upper half of frame removed.)

The principal parts of the bearing are made of forged and cast steel and the slippers are lined with white metal. The bearing is lubricated by a continuous circulation of oil which is admitted near the bottom and completely fills the casing, the outlet pipe being led from the top of the casing into the gear box.

The revolution counter is driven by spiral gears on the end of the gear shaft.

As shown in Fig. 12, two oil pumps of the spur gear type are driven from the first reduction gears through spiral gears at a normal speed of 335 revolutions per minute. The pumps are located near the bottom of the drain tank and are provided with double suction and discharge valves so that they will pump with rotation in either direction—i. e., ahead or astern.

CONDENSING PLANT

The condensing plant* is of the latest Westinghouse type for producing the high vacuum required by turbines.

The condenser is of the steel plate type with cast iron heads, and is arranged for three passes of the cooling water. The tubes are ⅝ inch outside diameter and are 8 feet 6 inches long between the tube plates, the cooling surface being 4,500 square feet. With 65 degree cooling water, the condenser is designed to produce a vacuum of 28½ inches of mercury referred to a 30-inch barometer.

* A description of the Westinghouse-Leblanc air ejector system for producing high vacuum is given in MARINE ENGINEERING, December, 1915, in an article by Mr. G. L. Kothny, entitled "New Vacuum Apparatus."

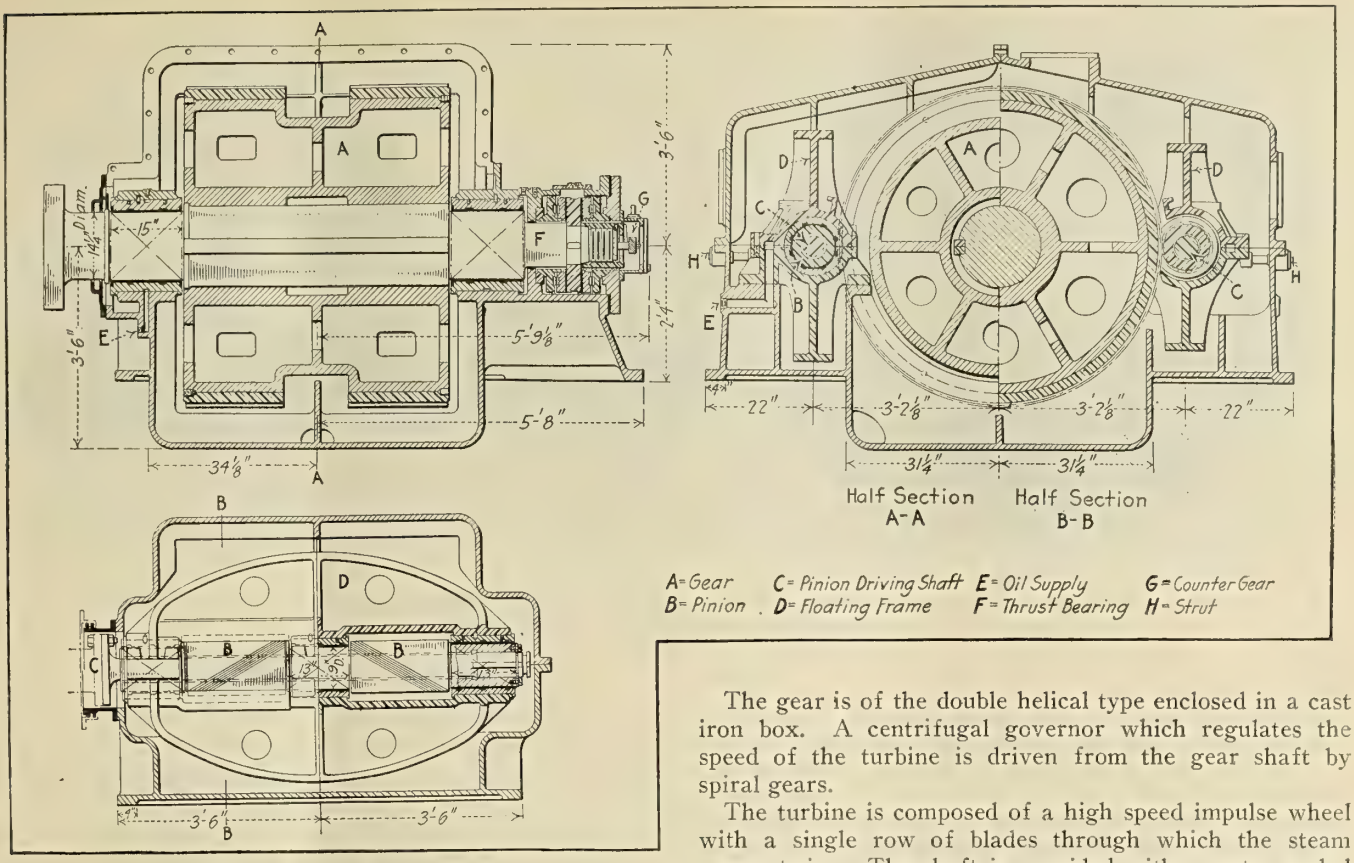


Fig. 14.—Second Reduction Gear

The circulating pump is of the single runner slow speed type designed for high efficiency, and is driven by a geared turbine unit, the revolutions of the pump being 550 and of the turbine 6,600. This gives a high efficiency for both pump and turbine, which results in a very economical unit. The pump has a capacity of 5,000 gallons per minute and requires 52 horsepower. When operating with 150 pounds of steam and 5 pounds back pressure, the estimated steam consumption is 2,340 pounds per hour, or 36 pounds per horsepower.

The pump body is of cast iron and is provided with a double inlet. The glands are packed with flax packing and are provided with water seals to prevent air leakage. The rotor is carried in two bearings, one on the gear and one on the pump body.

The gear is of the double helical type enclosed in a cast iron box. A centrifugal governor which regulates the speed of the turbine is driven from the gear shaft by spiral gears.

The turbine is composed of a high speed impulse wheel with a single row of blades through which the steam passes twice. The shaft is provided with a water sealed gland where it passes through the casing. At full speed, the speed of the turbine is regulated by the governor, which operates a balanced valve, the lower speeds being obtained by hand throttling.

The turbine bearings and reduction gear are supplied with a continuous circulation of oil from the main lubricating system, the gear teeth being lubricated by sprays.

There are two condensate or hot well pumps for withdrawing the condensate from the condenser. One pump is sufficient to serve the condenser up to maximum power, the second being provided as a spare for emergency use. The pumps are of the centrifugal type and are direct turbine driven. They are located below the condenser so that the condensate will drain into them by gravity. The water is discharged up into a small tank from which is taken the gland sealing water and from there it over-

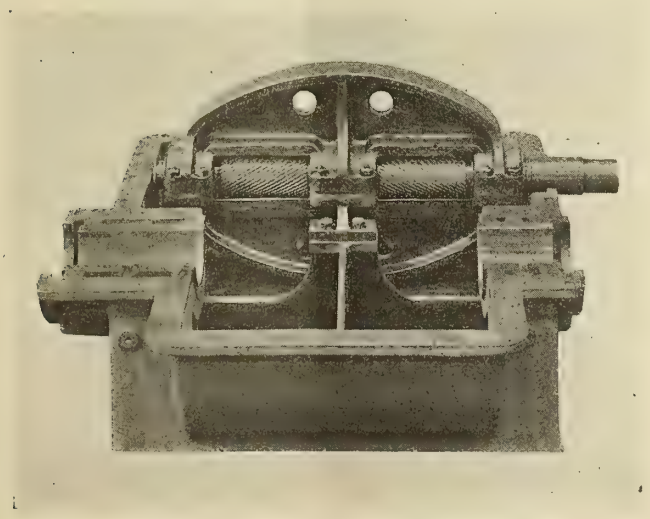


Fig. 15.—View of Pinion and Floating Frame in place in Gear Box. (Gear removed, Gear Bearings in place.)

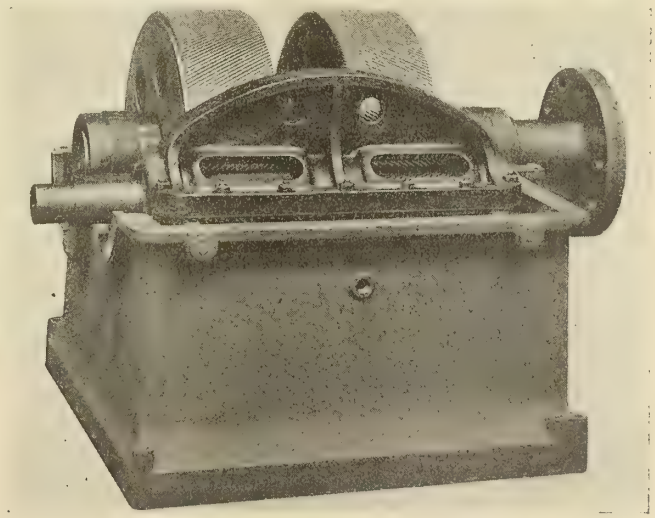


Fig. 16.—View of Gear with Cover of Gear Box removed, showing Floating Frame, Pinion and Gear

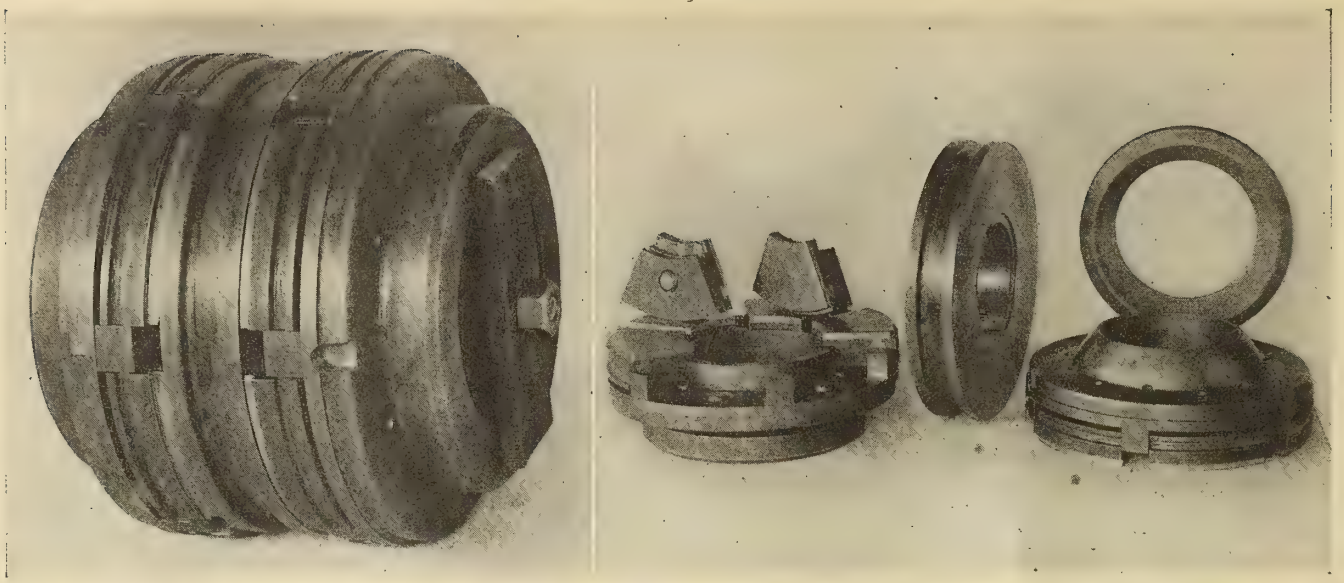


Fig. 17.—Views of Kingsbury Marine Type Thrust Bearing Assembled and Apart, showing Segmental Pivoted Thrust Slippers and Self-Alining Slipper Ring with Spherical Seat

flows to the air ejector tank, and thence passes into the feed tank. Each pump has a capacity of 50,000 pounds per hour and requires 6 horsepower. The revolutions per minute are 2,500, and the estimated steam consumption 650 pounds per hour.

The pump is of bronze and is of the single inlet type with a water sealed gland to prevent air leakage.

The turbine is of the impulse type with a single row of blades through which the steam passes twice. The casing is split horizontally and lagged and fitted with labyrinth type glands. The rotor is carried in two ring oiled bearings. The speed is regulated by a centrifugal governor, mounted on the turbine shaft, which operates a balanced governor throttle valve.

Westinghouse-Leblanc air ejectors are provided for withdrawing air from the condenser. There are two ejectors, one being sufficient for full load requirements, and the other being provided as a spare. The air is withdrawn by multiple jets of steam in series which compress it to atmospheric pressure. The mixture of air and steam passes into the air ejector tank, where the steam is condensed and the air escapes to the atmosphere. The air ejectors are made of bronze and the tank of steel plate. The estimated steam consumption is 1,760 pounds per hour for two ejectors, and the weight 97 pounds each.

Lubricating System

As shown in Fig. 18, oil is supplied to the gears and turbine under a pressure of about 5 pounds from a gravity tank. The oil first passes through a cooler, and is then supplied to the bearings and gear teeth, after which it drains back into the second gear box, and thence it passes into the drain tank. From the drain tank it passes into the oil pumps, which discharge it back into the gravity tank through the strainers located in the top of the tank. When the main units are in operation, the oil is pumped by the rotary pumps driven from the first gears. When stopped, running slowly, etc., the independently driven auxiliary oil pump is used.

The gravity, drain and storage tanks are of steel plate of rectangular form, and the piping is of galvanized iron. The cooler is composed of a nest of condenser tubes in a cast iron box. The cooling water passes through the tubes and is supplied from the main circulating pump. The auxiliary oil pump is of the Smith-Vail horizontal duplex steam piston type.

Distinctive Features of Machinery Installation

It is of interest to note that all of the machinery in this installation (except the air ejectors and auxiliary oil pumps) is of the rotary type, which embodies a number of novel and improved features for marine machinery.

The machinery weights are considerably less than is usual with reciprocating engines. The weight per shaft horsepower of the geared turbine installation is 61.5 pounds per shaft horsepower, or 56.5 pounds per indicated horsepower, whereas an engine installation would weigh about 110 pounds per indicated horsepower.

In general, the construction of the machinery is heavy and rugged, and ample precautions have been taken to obtain safety and reliability of operation throughout. There are two turbines which are arranged so that either turbine can be cut out and the other operated independently in case of emergency, thus guaranteeing safety against breakdown. The vessels could always proceed at reduced speed, and with backing power available. The main turbines are provided with safety overspeed governors which prevent the turbines from exceeding the maxi-

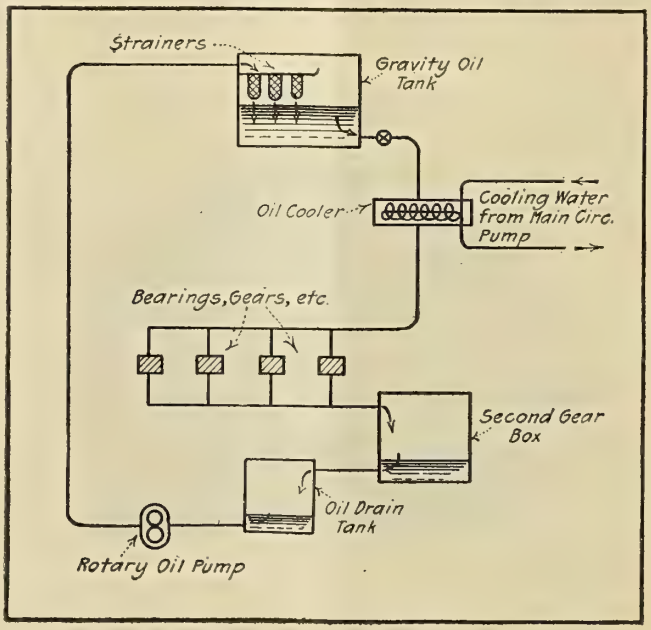


Fig. 18.—Lubricating System

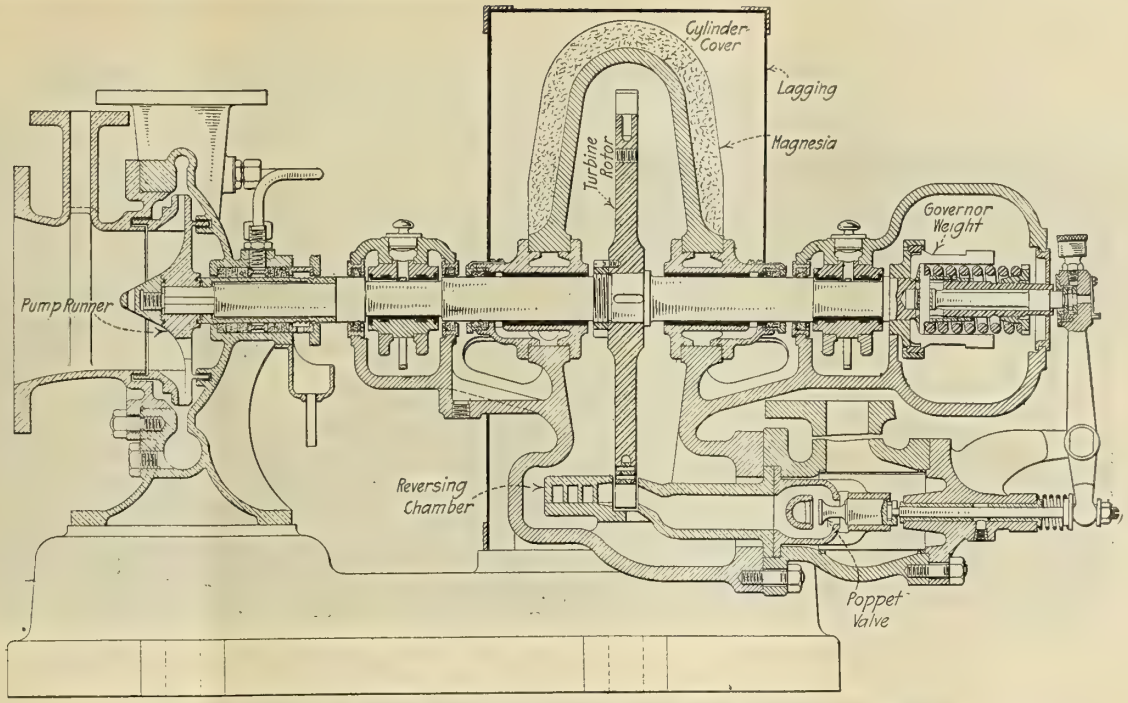


Fig. 19.—Section Through Condensate Pump Unit, showing Turbine and Pump

mum speed. They do not, however, stop the turbines, which might be troublesome, particularly in the case of the propellers racing in a heavy seaway.

The turbines have a considerable overload capacity and reversing power, the latter being 60 percent of the ahead full power with the same flow of steam, and about 80 percent when the flow of steam is increased during the short reversing period—not over two minutes usually. This reversing power is about the same as that of reciprocating engines and is quite ample for all requirements.

Many who are not familiar with geared turbines have the impression that with this type of machinery, insufficient backing power is characteristic, the same as with direct drive turbines from which the present type was evolved. This, however, is not correct. With the direct drive machinery, due to the unfavorable speed under which they operate, the efficiency of both the turbine and propeller is low, giving a very low overall efficiency. With the geared machinery, both the turbine and propeller operate at speeds which give high efficiencies for both turbine and propeller, and relatively a much higher overall efficiency, or stopping power. It is obvious that by doubling the efficiencies of both turbine and propeller, the power of the turbine is doubled, and that of the propeller —i. e., the effective stopping power—is quadrupled, which is substantially the relation between direct drive and geared turbines.

It may be added that the size and efficiency of the propellers are of more importance than high backing power. In stopping the vessel, the large propellers used with geared turbines "take hold of the water" better up to their breaking down point, beyond which additional power is of little advantage. With the maximum flow of steam, geared turbines develop about as much power as can be used effectively by the propellers.

The turbines are provided with group control of the nozzles to obtain more economical use of the steam at reduced powers. In addition to the usual steam seals for turbine glands, water seals also are provided for use while the turbines are in normal operation, since they give a perfect seal with absolutely no leakage whatever of steam into the engine room. Water seals have been extensively used on land turbines and have given most satisfactory results.*

The turbine blading is of the Westinghouse standard type and is particularly rugged and substantial. The blades are held in the rotor by mechanical locks and are amply secured against vibration.

The reduction gears are the latest Westinghouse type with mechanical floating frames to maintain the pinion alinement. The Kingsbury thrust bearing incorporated in the second gear is a considerable improvement over the usual type of thrust block. The measurement of power with the hydraulic dynamometers is a desirable feature for checking the ship's performance in service. The duplicate direct driven rotary oil pumps are very simple and reliable and are claimed by the manufacturers to be more economical than independent pumps, besides requiring less attention.

The condensing plant has many important improvements. The turbine driven rotary pumps are also claimed to be a great improvement, both mechanically and economically, over the reciprocating types. The geared turbine drive on the circulating pump permits a slow speed pump and a high speed turbine, resulting in a very economical unit. These rotary machines require a minimum of attention and repairs. The Leblanc air ejectors are a great improvement over air pumps with respect to steam consumed, weight, space, care and repairs. It is an exceedingly simple static machine which requires the minimum attention.

As far as is known, this is the first marine installation in which propelling machinery, both main and auxiliary, is entirely of the rotary type. Since the advantages of rotative machinery are considerable, it is believed that the present installation is preliminary to the more general adoption of rotative main and auxiliary machinery for marine service.

* For seventeen years all Westinghouse turbines except some small impulse turbines have been equipped with water sealed glands.

VIEWS OF SKINNER & EDDY SHIPYARD AT SEATTLE

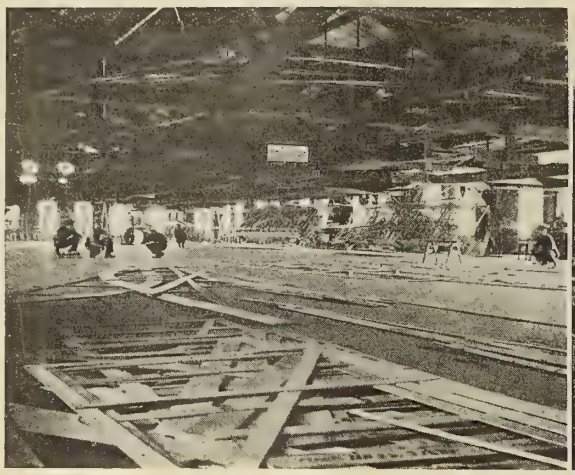


Fig. 1.—Mold Loft

Fig. 2.—Shipfitters' Layout Area and Plate Racks

Fig. 3.—Drafting Room

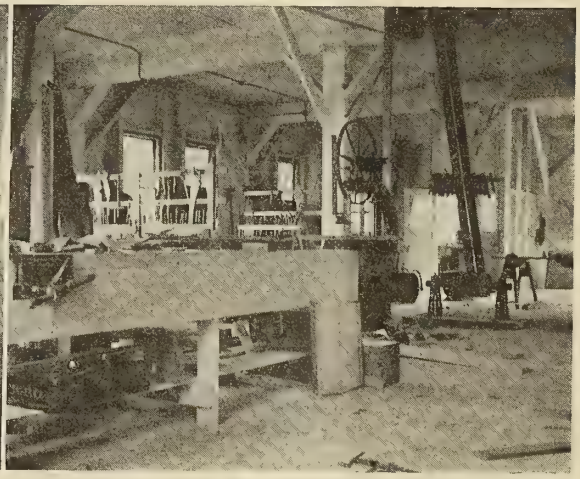


Fig. 4.—Pattern Shop

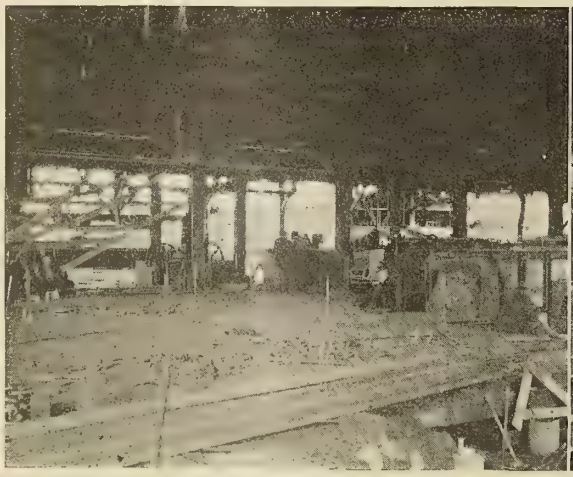


Fig. 5.—Bending Slabs and Furnaces

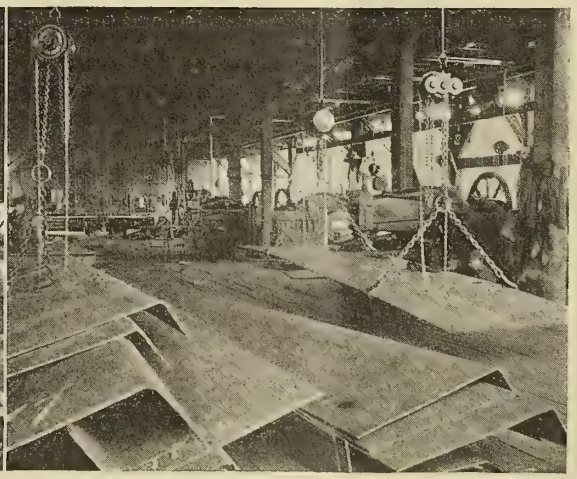


Fig. 6.—Plate and Angle Shop

Fig. 7.—General View of Skinner & Eddy Shipyard

The New Skinner & Eddy Shipyard

Steel Shipbuilding Facilities on Puget Sound Increased by New Plant Covering Twenty-Three Acres

BY GILBERT C. DOHM

WITH the revival of shipbuilding in this country, due to the present great demand for merchant ships, the Pacific Coast is doing its share toward furthering the progress of this industry. From the Canadian to the Mexican border a number of yards have been organized or are being organized to take care of the demand for new ships, or the repairing of the older ones.

Seattle has been particularly fortunate in this respect in the establishing of a new large steel shipbuilding plant by the Skinner & Eddy Corporation of that city.

On the site of the old wooden shipbuilding yard of Nelson & Kelez, and with much additional area added thereto, this yard was built up. The last ship launched by Nelson & Kelez was called the *Progress,* which name seemed to have been a forerunner of the present establishment, for immediately after this launching the building slips for the steel ships now under construction were prepared.

Covering approximately an area of 23 acres, and situated on Elliott Bay, with its deep and open fairway into Puget Sound, and adjacent to Seattle's busy waterfront and commercial center, the location of this yard is ideal for handling work of large size. Material is received over five transcontinental railroads—the Chicago, Milwaukee & St. Paul, Oregon-Washington Railroad & Navigation Company, Great Northern, Northern Pacific, and Canadian Pacific, and also over the Columbia and Puget Sound. As the yard property parallels a portion of the railroad tracks, it was only necessary to lay down a short siding to connect with the tracks already within the yard limits. Material can therefore be conveyed to any part of the plant on the railroad company's cars, or taken directly to the storage racks and transferred to these by the traveling cranes.

Preparations for the building of this plant were made last December, with the idea of having an equipment with which to turn out a number of ships for the private use of the Skinner & Eddy Corporation. This idea was soon after enlarged upon, when a sufficient number of contracts were available for the building of ships for other interests, and equipment sufficient for handling the work on four ships under construction at one time was installed.

Due to the scarcity of structural building material and the urgent need for fabricating buildings, mold loft, etc.,

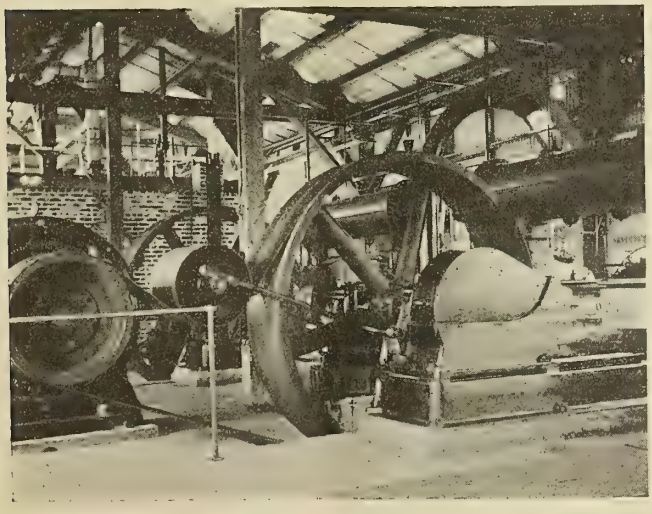


Fig. 8.—Interior of Power House

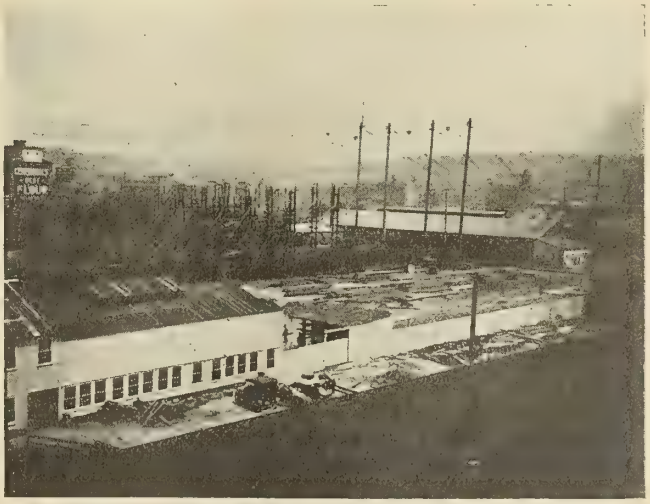


Fig. 9.—Aerial Tramway for Conveying Material

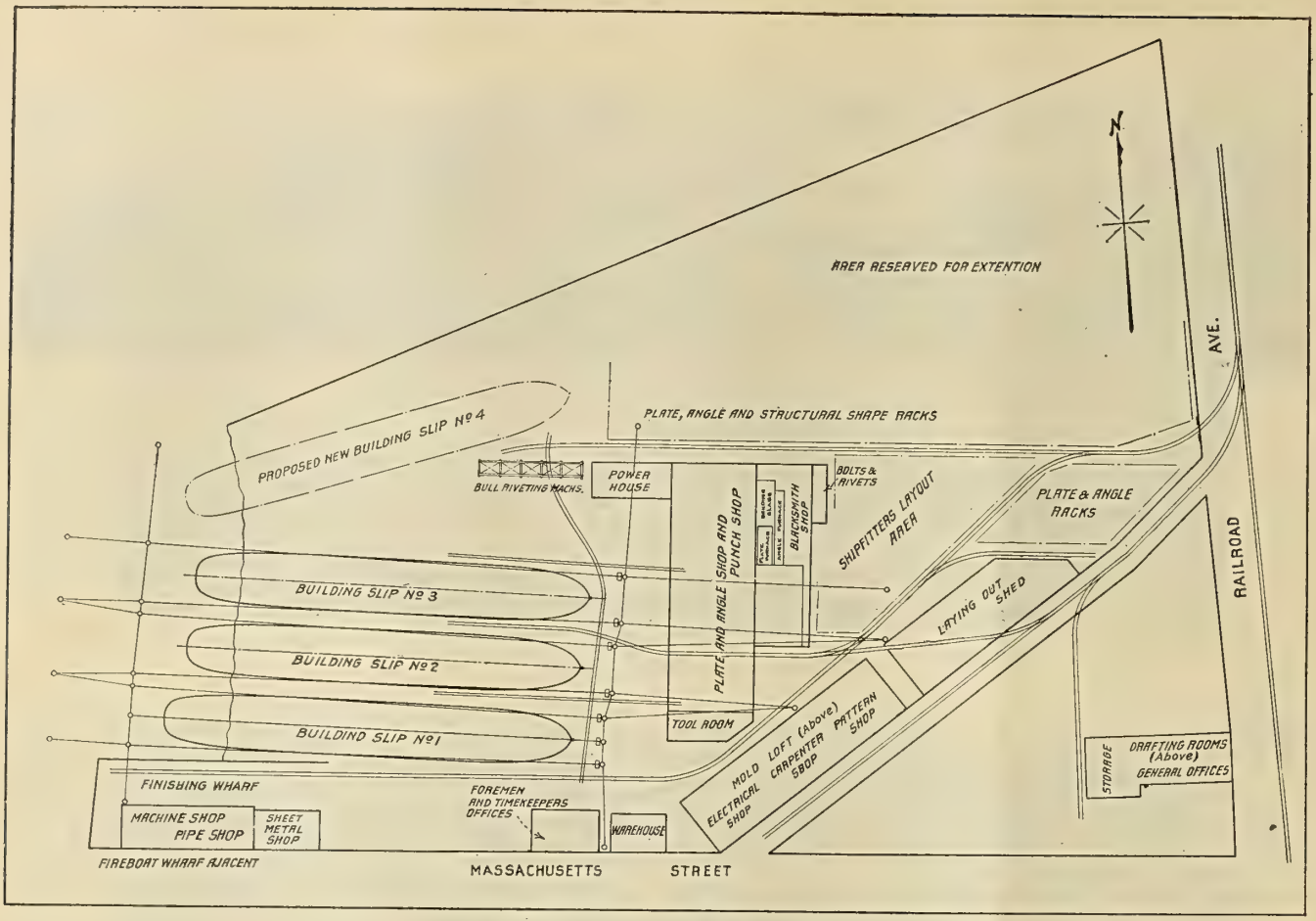


Fig. 10.—Plan of Skinner & Eddy Shipyard

it was deemed advisable to erect suitable temporary structures of heavy timber, which is available and can be had on short notice in the West. The stress members were all well braced and made of sizes sufficiently great to withstand the shocks from the overhead traveling cranes, the jib cranes which serve individual machines and the wall cranes. On account of this timber construction, very efficient methods of fire prevention and fire control were immediately installed.

The layout of the plant is as shown in Fig. 10. Much of the open space is used at present for the storage of the plates and structural shapes which the company has been successful in placing contracts for, and which material is constantly arriving. There is also a portion of the yard set aside for the storage of structures and parts built up or bent into shape beforehand, such as floors, frames, shaft alley framing, beams and brackets, etc., and awaiting to be installed on their respective ships.

The power house, which is the source of all energy for the yard, is equipped with two Chicago Pneumatic Tool Company's air compressors of 14,000 cubic feet capacity each, which supply the compressed air for the drills, riveting and reaming machines, and also five bull riveters. These compressors are driven by a Westinghouse 200 horsepower motor. Another compressor of 500 cubic feet capacity is soon to be installed. Steam for use in the blacksmith shop, plate and angle shop, yard heating system, winches, etc., is furnished by a 150 horsepower oil burning boiler. The furnaces and forges in the yard are also oil burning and fuel under pressure is received by them from an oil pump located in the power house. The steam and oil lines are all carried under ground.

The plate and angle shop is fully equipped with planers, reamers, shears, rolls, drills, punching machines, etc. A bolt and rivet making machine has also been installed.

The blacksmith shop and furnaces are also complete and up to date.

The mold loft, which was recently raised bodily 12 feet, to permit the building of a carpenter shop, joiner shop and electrical shop below, has upon its floor at present the lines of ships Nos. 3 and 4.

The machine shop, pipe shop and sheet metal shop are still under construction and will be completed by July 10.

Particular attention has been given in all cases to the ease and systematic routine of conveying the structural shapes through their various stages, from one point to another, with the least possible mechanical energy.

A unique feature is the method of conveying the structural shapes and plates to the ship. To install cranes would have necessitated the spending of considerable time which was not then available. To overcome this difficulty a system which is used to some extent abroad was installed. Upon an aerial tramway on either side of the ship, consisting of a fixed wire cable supported by two timber uprights, travel two trolleys which carry the hoisting cables and shackles. These uprights are about 16 inches in diameter at the top, and being the natural tree assume their own diameter at the bottom. They are placed at the forward and after ends of the ways, the forward upright being about 100 feet high and the after upright, which is out in the water and sheathed in copper, about 90 feet high. Both are set into the ground about 10 feet and canted away from one another at an inclination of one foot cant to 7 feet length of upright and are stayed in position by cables fastened to dolphins about

SHIPWAYS AND AERIAL TRAMWAYS

Fig. 11.—Building Ways

Fig. 12.—Looking Forward in Building Slip

Fig. 13.—Conveying Beam to Ship

Fig. 14.—Placing Beam in Position

150 feet away. The cable assumes the shape of a catenary when free of any weight and is 1¾ inches in diameter.

The hoisting cables are operated by means of two electric winches at the forward uprights, signals being given to raise or lower from any position on the ship to the operator at the winch by a bell system. As the uprights supporting the two tramways are at a greater distance apart than the breadth of the ship, the material is carried out, suspended from both trolleys, and when the proper athwartship position is reached, the hoisting cables are lowered in such a manner as to swing the structure into its proper position. Due to the declivity of the tramway no power is required to take the material out and only sufficient power is required after the material has been delivered to bring back the empty trolley.

Upon smaller wires stretched from upright to upright runs a trolley conveying the wire and electric push button for signaling, the two supporting wires serving also to carry the electric current.

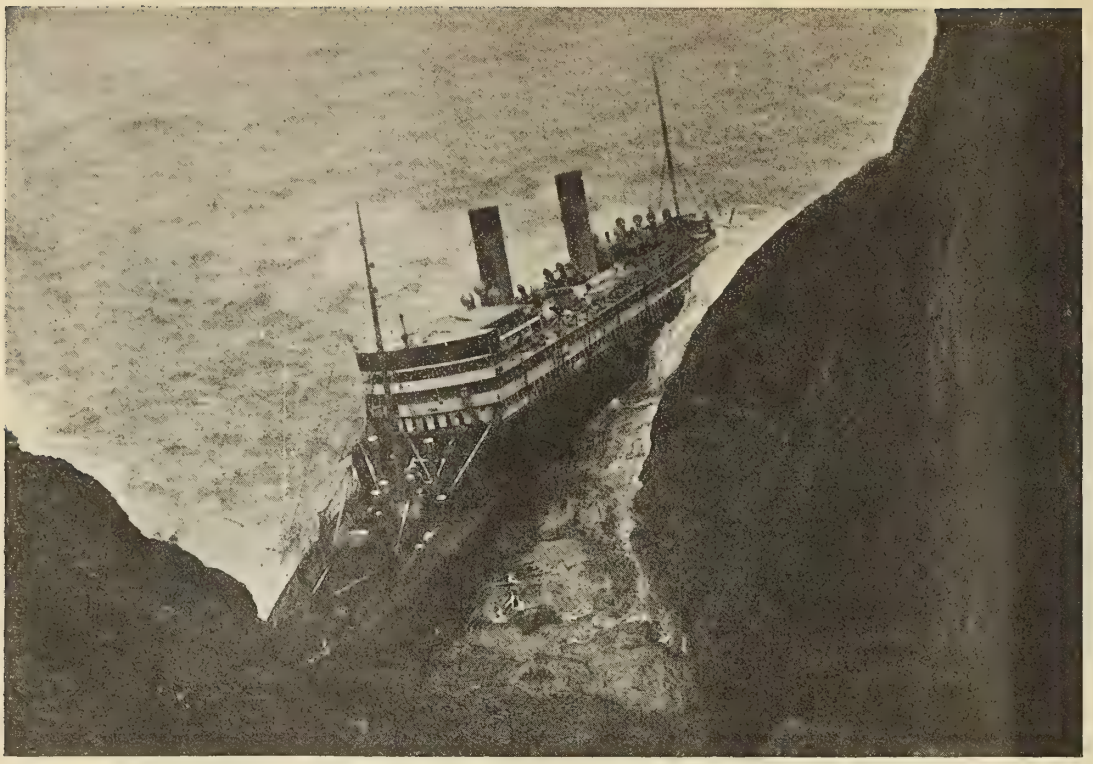
This method of conveying has been found extremely efficient and economical, and with a little practice on the part of the weight handlers is easily managed.

Two building slips are now completed, a third is under construction, and a fourth will soon be started. Work has advanced rapidly on two ships which are now about twenty-five percent to fifty percent complete, and a third will be started as soon as the keel blocks are prepared.

Immediately upon launching the ships will be taken to the finishing wharf adjacent to the machine shop and the machinery installed and final adjustments made.

Contracts for six ships are at present on hand. The yard employs about 1,900 men and is working three eight-hour shifts a day.

Diesel Engined Excursion Boat.—A new sight-seeing excursion boat, the *Palisades,* was recently placed in commission by the Palisades Interstate Park Commission, to run between New York City and the various playgrounds of Palisades Park. The vessel is of the house-boat type, 120 feet long, with a capacity for 300 passengers, and is propelled by Southwark-Harris valveless heavy oil engines, built by the Southwark Foundry & Machine Company, Philadelphia, Pa.



Photograph by International Film Service

Fig. 1.—Position of the Chiyo Maru on the Rocks Outside Hong Kong Harbor

Wreck of the Japanese Liner Chiyo Maru

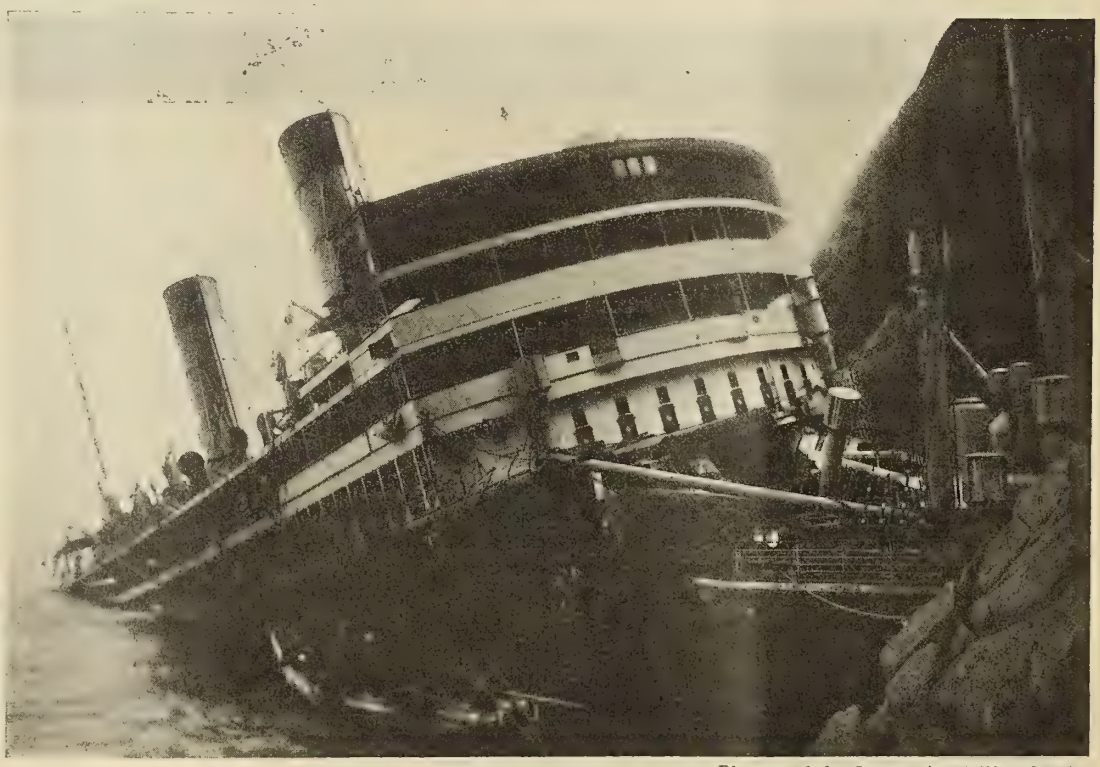
During a dense fog on the night of March 31, 1916, the Japanese liner *Chiyo Maru,* of the Toyo Kisen Kaisha Steamship Company, ran aground on Lema Island near the entrance to Hong Kong harbor. The accident occurred a little after midnight when everything was in complete darkness. The illustrations shown on this page, taken a few hours later, show plainly that the surf in washing over the vessel's stern had already broken her apart. No lives were lost, however, as, in spite of the fact that the ship had a considerable list, all of her passengers and crew were saved in lifeboats, and within a few hours were transferred to a British torpedo boat destroyer and brought to Hong Kong. The fact that all lifeboats on the vessel were successfully launched under very severe conditions without the loss of a single life testifies to the efficiency of the Welin quadrant davits with which the ship was equipped.

After salvage operations had been undertaken, the vessel became a complete wreck and has since been abandoned.

The *Chiyo Maru* was 575 feet long, 63 feet beam and 46 feet 6 inches depth, molded to shelter deck. She was of 14,000 tons gross register, 22,000 tons displacement and had a carrying capacity of 275 first class, 54 second class and 800 Asiatic steerage passengers.

The vessel was insured in the Tokyo Marine Insurance Company for 4,000,000 yen and reinsured in several London companies. After the insurance adjustments are settled the wreck will be sold at auction and the iron, steel, brass and other metals used in the construction of the vessel will have considerable value in the present market.

Trial Trip of the Tioga.—On the trial trip of the new harbor cutter *Tioga,* recently launched at Solomon's Island, Maryland, the vessel developed a speed of 9.6 knots.



Photograph by International Film Service

Fig. 2.—Break in the Hull Forward of the Superstructure

Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Refitting Main Bearings

Recently, after completing a 12,000-mile cruise, it was found necessary to refit several of our main bearings, both top and bottom. The top cap is of steel with babbit lining and the lower half of composition. On removal it

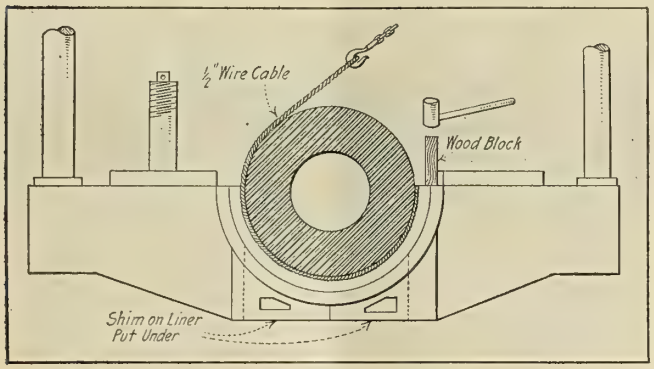


Fig. 1

was found that the top caps had run or wiped the white metal, so that the oil grooves were filled in the lower half, necessitating their removal.

As work was being done in the cylinders and other parts of the engine, the lower brasses could not be turned out with the jacking engine, so a chain fall and piece of wire cable were used, as shown in Fig. 1. This method proved to be much better, as well as quicker, allowing the weight of the crankshaft to be taken up by blocking and wedges. A strain was taken on the cable, assisted by a heavy maul and wood block, as shown in Fig. 1. To be more effective, the chain fall should be shifted to various positions.

Fig. 2 shows the oil grooves in the lower brass. The plain circular grooves were all that were in the brass. On removal the four wing grooves, as shown by dotted lines, were added. This provides a small reservoir to accumulate oil when the engine is stopped with the oil wicks in.

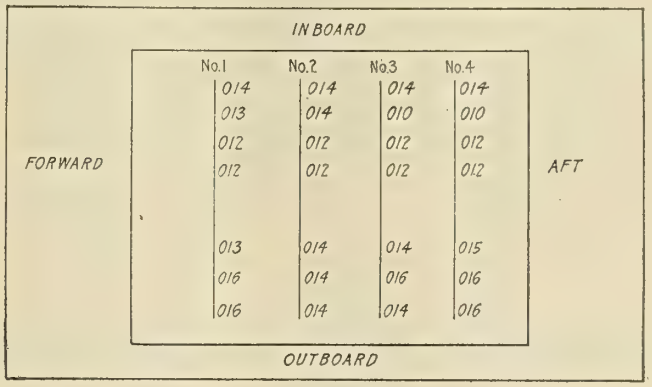


Fig. 3

The lower brass was spotted into the shaft and scraped, then replaced and feelers used to see that the shaft bedded in it. It was found that a two-thousandths shim was needed to raise it. It was again rolled out and a shim put under the shoe in which the brass sets, and again replaced.

The top caps were refitted by taking leads. When the set of leads is taken out of the cap they are measured and their thicknesses are written on a sheet of paper, as shown in Fig. 3. This shows at a glance the way in which the bearing cap sets and shows the "high spots." With this paper in front of you, when you are scraping the cap, you are prevented from scraping the wrong part of your bearing.

C. H. W.

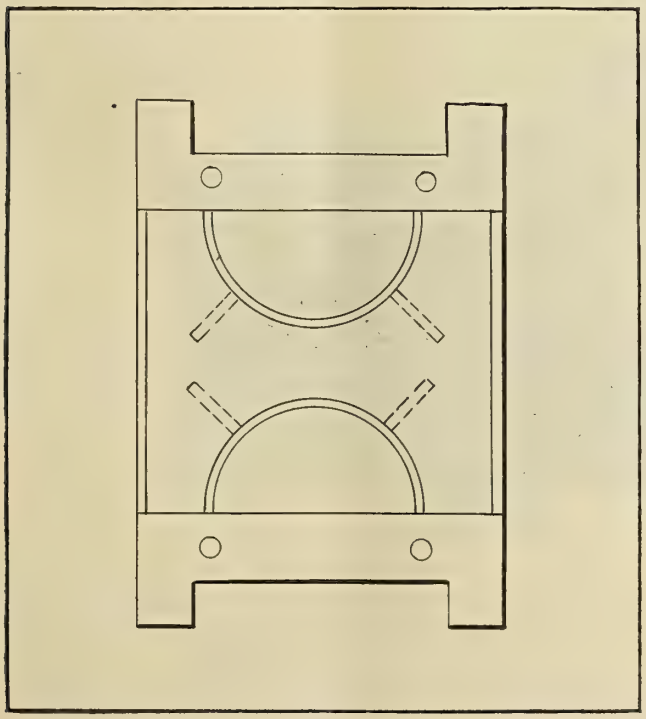


Fig. 2

Indexing and Filing Engineering Data

Following the suggestion made in one of the editorials in the April issue, I am enclosing a few samples of my index cards to show the method I use in filing and classifying data on engineering subjects.

SHIP, Unsinkable,

A very interesting communication on the possibility of building a large passenger liner that would not under any of the known mishaps at sea lose her buoyancy, or stability and sink.

By George W. Dickie.

Sc. American, Vol CX, pp. 86 & 91.

1913 Proceedings of the S.N.A.& M.E.,--.25-29

Int.Mar.Eng.,Vol. XIX, pp. 60-62.

Fig. 1.—Index Card

MERCHANT VESSELS, Notes on the performance of the S. S. "TYLER".
A plea for adequate trial trips of merchant vessels- Trial data from an interesting cargo steamship built for the Old Dominion Line.
By E. H. Rigg.
Int.Mer.Eng. Vol. XIX, pp. 29-31.

Fig. 2.—Index Card

My course of action in this regard is as follows: In looking over the pages of a technical publication, book or magazine, I carefully read over any article bearing on my daily work or any article which seems of value from the standpoint of general knowledge. Then an index card is filled out with the title of the article and the name of its author, followed by a comment or note regarding the nature of the article, and finally by a note stating where the article can be found.

AUG. SUZARA,
Steamboat Inspector.

Cebu, P. I.

Deterioration of Tail Shafts in Tropical Waters

The illustrations show three views of sections of the port tail shaft of the steamer *Marinduque*, a twin screw survey steamer of 411 gross tons, used by the United States Coast and Geodetic Survey in the Sulu Sea along the coast of Palawan Island, P. I. The tail shaft is 6 7/16 inches diameter and 9 feet 2 inches long between the stern bearing and strut bearing. Composition sleeves are fitted on the shaft at the bearings and the hull is of composite build sheathed with yellow metal and fitted with composition propellers. The temperature of the sea water is about 86 degrees Fahrenheit.

The shaft shown in the illustrations was installed new and painted with three applications of black asphaltum, well dried between each coat before the shaft was installed. The shaft was not served with marline or other protection, as the steamer was needed at once to go to the aid of a survey party on Dumaran Island.

At the end of six months the steamer was hauled out on a marine railway and the deterioration was found to be so great that the shaft was condemned. In the illustrations, where the shaft appears smooth, the asphaltum is as good as when applied, but where the shaft was attacked, it is in a condition resembling decayed wood.

This is the third port tail shaft on this vessel which

Fig. 2.—Port Tail Shaft, showing the Brass Sleeve which Rests in Stern Bearing. Deterioration More Pronounced Next to Stern Bearing and Hull

Fig. 3.—Yellow Metal Sheathing Composition Sleeve on Shaft in Stern and Strut Bearings

Fig. 1.—U. S. S. *Marinduque* Coaling at Puerto Princesa, Palawan, P. I.

Fig. 4.—Tail Shaft, Yellow Metal Sheathing Composition Sleeves on Shaft. Composition Propeller. Temperature of Sea Water 86 Degrees F. Time in Water, Six Months

has deteriorated in this manner. The shafts are 8 feet apart and turn inboard. Between the two main thrust bearings is a 10-kilowatt dynamo. The steamer *Marinduque* was built in Uraga, Japan, in 1902.

C. M. Conover.

Puerta Princesa, Palawan, P. I.

Leaky Boiler Tubes

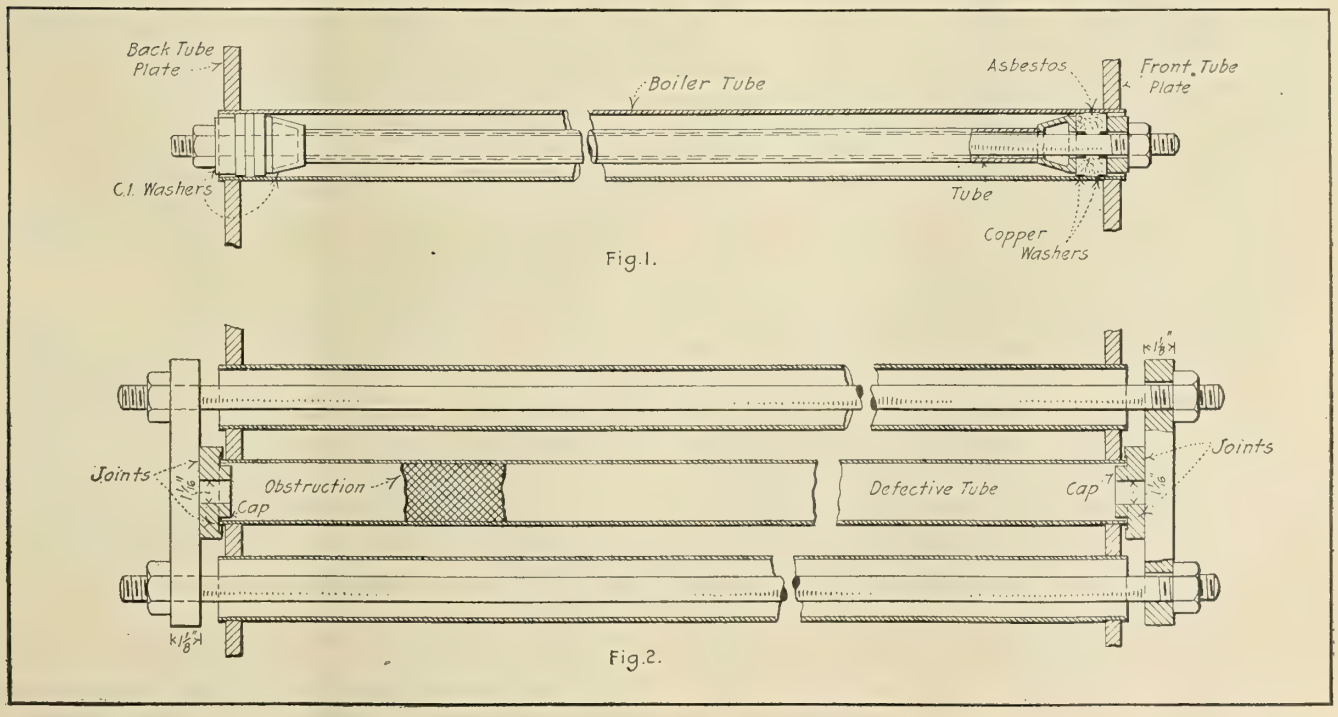
The boilers in a passenger ship I sailed in were of the marine multitubular, wet bottom type, better known as the Scotch boiler. Two of them were double-ended and two single-ended. Their condition was very bad, especially the tubes, which were constantly giving out. When we observed signs of a leaky tube—water coming from the ashpit or smoke casing door—we opened the latter, and, if at all possible, fitted a tube stopper, as shown in Fig. 1.

These we found very serviceable if the leak was not too great to permit of them being fitted. We always tried this method first, as it did not necessitate the shutting and blowing down of the boiler to get into the combustion chamber, thereby saving much time and delay—an important factor to a passenger ship. This reasoning applied more to the double-enders, which, if put out of action, meant a great reduction in speed for a considerable time.

The particular case which I wish to speak of was the worst we had, and happened when homeward bound, some five or six days from port. The first indication we had was water coming from center smoke casing door of one of the donble-ended boilers. The forced draft was shut off to the center furnace, the fire allowed to die down, then drawn, particular care being taken to regulate the feed. The ashpit and casing doors were than opened by means of a rake, everybody standing clear. We always took this precaution, because, with a closed ashpit, one never knew how much scalding water might have collected there. I remember in the same ship a fireman got badly scalded about the feet through deliberately unheeding the warning to stand clear.

To continue, we lifted the casing door up horizontally and located the leaky tube. A patent tube stopper was tried in, but it would only go a certain distance and no further. This seemed strange, so, withdrawing it, we tried a long stay, but with the same result. There was soot, and probably salt, in a solid mass choking the tube. We observed that in this case no water was coming from the back end through the ashpit, so we concluded that the leaky part of the tube was between the obstruction and the front tube plate. As to the distance that existed between the break and the obstruction, we could not possibly find out; however, we determined to fit a stopper, so cutting the stay and its tube to the required length and screwing the former, we inserted it, tightened up the nuts, and were successful in stopping the leak.

Two or three days afterwards we were much annoyed to see water coming from the same door, and when it was ascertained to be the same tube we vented our feelings in the profane manner peculiar to marine engineers. We tightened up the nut, but as that failed to stop the leak, the chief decided to draw all six fires, shut and blow down the boiler, and when cool enough, examine the faulty tube from the back end. From there it was found that a short chisel bar would only go about 14 inches into the tube. All means were tried from both ends to remove the obstruction, but with no success; even a slice per-



Construction and Arrangement of Tube Stoppers

suaded by a "Monday" hammer failed to make a passage. Our idea, had we succeeded, was to fit an ordinary tube stopper. (Fig. 2 shows the details of such a stopper, only the caps and stays are in different tubes.)

The tube had to be blanked off somehow, so in preference to cutting it out, we made the following repair quickly and in such a manner that we had no further trouble.

Two stays, 1 inch diameter, were put through the neighboring tubes, as shown in Fig. 2. Joints of well-made red lead putty and gauze wire were inserted between the ends of the tube and caps. Two plates, 1⅛ inches thick, were in the meantime being prepared to fit over the ends of two stays, and of sufficient breadth to cover the cap. Two other joints of same material were put between the caps and plates.

When everything was ready the nuts were screwed up, care being taken to put an equal strain on both stays, so as to prevent the plates canting.

The boiler was filled up, and when water was past the tube level all was tight. When steam was raised a little more tension was put on the stays from the front end. As aforesaid, we had no further trouble with this tube.

When we reached port a good many of the tubes were renewed, to the great satisfaction of the ship's engineers.

"VAKITID."

Analyzing a Marine Steam Plant*

A good boiler will, under favorable conditions, absorb 80 to 85 percent of the heat given off by the fuel; but more usual results range from 60 to 70 percent, and some boilers of poor design, in poor condition, will run as low as 50 percent, particularly if crowded. To be efficient a boiler must have plenty of heating surface as compared to the grate surface and must not be crowded in respect to the load it carries. Practical conditions demand a compromise between efficiency and capacity. Also it must be remembered that it is not pounds of coal per horsepower that the owners care about, but the pounds of coal per mile traveled with passenger ships and pounds of coal per ton of freight per mile with cargo boats. The coal used per ton of freight is much more important than the coal per horsepower, and some boats make a better showing per ton mile when their steam plant shows a larger amount of coal per indicated horsepower. All steamship economics, whether expense or revenue, should be figured out on a basis of a ton mile, rather than per horsepower, because this gives a basis by which expenses and supplies can be compared with revenue.

The efficiency of the boiler depends upon the soot in the tubes and the scale within the boiler, among other things. The proper care of soot and scale is so well known to the practical engineer that nothing need be said, except to emphasize the importance of anything that will help these conditions, as they greatly affect the economy of the boiler.

Many more boilers are improperly designed than generally supposed. They are strong enough, for the government sees to that; but the proportions are often not what they should be. The boiler has been built cheaply, and is small for the work expected or does not make proper allowance for reductions in pressure required by the government, or the smokestack is small, or large, or not high enough, or the tubes are not proportioned in area to the furnace, or are too short to bring the gases down to a proper stack temperature.

* For previous letters on this subject see April, May and June issues.

The following are some of the proportions adopted in boilers which gave results as noted. These boilers and tests have been selected from widely different sources, but all of the tests were conducted with coal of approximately the same analysis and the tests were made under fairly similar conditions.

Name of Boiler.	Watertube Type.	Scotch Type.
Economy tests:		
Heating surface	35 to 40 ratio	24 to 30
Grate surface	35 to 40 ratio	24 to 30
Coal burned per square foot grate surface per hour	8 to 12 pounds	20 to 24 pounds
Percent ash	9 to 12	9 to 12
Water evaporated from 100 degrees F. to 70 pounds	About 2.75 pounds	.....
Water evaoprated from and at 212 degrees F	About 11 pounds.	About 9.9 pounds
Stack temperature	400 to 600 degs. F.	700 to 900 degs. F.
Boiler horsepower	About 85.	.....
Capacity Tests:		
Water evaporated from and at 212 degrees F	9 to 11 pounds	9 pounds.
Boiler horsepower	About 110.	.....
Coal burned per square foot of grate surface	.....	38 pounds.

In comparing boilers the most important characteristic is the ratio between the heating surface and the grate surface. In highly economical boilers this figure rises to forty—that is, the heating surface is forty times the grate surface. Some boilers on land, notably the German Fermenich, have as high as 64, but 40 is the average for a watertube marine boiler, while Scotch boilers vary from 25 to 35. On the other hand, the Scotch boiler must burn more coal per square foot of grate surface in order to compensate for its deficiency in heating surface.

The Scotch boiler weighs more and takes more space than any other type of steam boiler in use to-day for the same power and steam pressure, with the single exception of the locomotive type, which is the heaviest of all. The arguments for the Scotch boiler are its relatively low cost, its ease of access and upkeep, its ability to steam for long periods without attention and its capacity for absorbing variations of steam consumption and firing, because of the immense body of water which it holds.

A watertube boiler, whatever its advantages, is a constant worry to a water tender, because of the quickness with which it "loses its water," and feed lines cannot be kept going absolutely without stoppage, and while an auxiliary feed line may be in perfect condition theoretically, it is often found at the critical moment with frozen valves, missing valve wheels, or plugged with dirt, or with a leaky, dried-out gasket in some joint, or the auxiliary feed pump has been used as a fire pump and is full of mud, etc. All of these elements must be considered in those larger economies which are realized from well kept schedules and reliable trips.

A Scotch boiler evaporates about ½ pound of water for each cubic foot of space occupied, and weighs about 2.3 pounds for each pound of water evaporated. A watertube boiler evaporates 1 pound to 1¼ pounds for each cubic foot of space occupied, and weighs 1 pound to 1½ pounds for each pound of water evaporated.

As this series of letters is intended to deal primarily with the analysis of existing plants, the foregoing explanations are made only that readers may "size up" an existing plant in which they may be interested, with a view to placing it with regard to what the plant *ought* to accomplish.

An engineer is always faced with two aspects of economy which are more or less opposed; he wants to operate as economically as possible, but a far more important feature is to be able to make his trips reliably and maintain his schedules to the last word. Repairs and improve-

ments must be so carefully planned that the earning power of the boat is not interfered with. When a boat is laid up, or coaling, or in drydock, it is not earning a revenue for the owners and the boat's ability to earn revenue is its only right to existence. When it cannot do that, it must be scrapped. It is well to keep the expenses down, but it is far more important to keep the earnings up. This side of the question must be considered in connection with the boilers more than any other part of the ship, as it is entirely a matter of judgment when they should be cleaned, repaired, etc. In the same manner must an engineer decide about the use of boiler compounds, zinc plates, feed water filters, purifiers, bottom blow, surface blow, and the extent to which the boiler is crowded. The deciding question in connection with each of these devices is, do they increase the earning power of the ship?

The writer has in mind a coastwise steamer which installed evaporators. They saved a small amount in fresh water bills, but took the services of a good man and helper for one day each trip to clean. The superintending engineer transferred them to a transpacific steamer and spent the money realized on devices for cooling off the fireroom, which resulted in such increased efficiency of the firemen that the earning power of the ship was perceptibly increased and the water necessary for the short coastwise trips was purchased outright.

Another chief found a boiler compound which removed practically all of the boiler scale, but it corroded the boiler and went over into the engine, coated all of the working surfaces and interfered with the lubrication, and the boat missed a trip while the engines were cleaned out and the corroded boilers thoroughly inspected.

The two important points of the operation of a steam boiler, relative to economy, are the condition of the surfaces of the metal transmitting the heat and the difference of temperature. If the surfaces are coated with soot on the outside and scale on the inside, the efficiency may be very low indeed. The temperature of ingoing feed water is something more than 120 degrees F. The boilers' temperatures run from 300 to 500 degrees where a superheater is used. The furnace temperature ranges from 3,000 degrees Fahr. to 1,000 or less in the stack. The difference between the temperatures of the furnace and boiler is a measure of the rate of flow from the furnace to the boiler. If the furnace temperature is very high, more heat will go to the boiler, but more will also go up the stack. If the fire is not crowded, the boiler gets more of the heat because the stack temperatures are not so high. It is doubtful if superheaters increase the earning power of a ship unless on very long voyages, when consideration is given to their upkeep and the difficulty of lubricating the high pressure cylinders and valves and the ever-present trouble with rings, especially where the high pressure cylinder is jacketed, as on the U. S. S. *Tacoma*.

Another phase of economy is the preserving of the life of a boiler. The policy governing this falls on the superintending engineer more than the ship's chief because, owing to the unfortunate condition of our merchant marine, the average chief does not look upon his position as sufficiently permanent to take a deep and abiding interest in the permanent preservation of his plant. Such care as this would include protecting the boiler from sudden changes of temperature, such as opening the connection doors or the furnace doors except when necessary, the careful use of boiler compounds and zinc plates, corrosion from various causes chemical and physical in character, and cleaning of the interior.

After the heat has once been transmitted to the water and steam, the problem becomes one of preventing its loss through radiation. The water and steam are only vehicles for the heat and the economy of the steam engine is limited by the physical properties of water and steam. Gas engines use the products of combustion as the vehicle of heat and are limited by their physical peculiarities. Refrigerating machines use ammonia, or ether, or carbon dioxide, or sulphur dioxide, or air, because each of these vehicles has properties which make refrigeration possible. When a pound of water is raised from about 120 degrees to the temperature corresponding to 165 pounds pressure, about 250 B. T. U. are required; then when the water is converted into steam, 850 B. T. U. in addition are required. Therefore, any condensation represents losses at the rate of 850 B. T. U. for each pound of steam condensed. The steam, as it arrives at the engine, contains from 2 to 10 percent of moisture. Take, for example, a 1,000 horsepower engine using 12 pounds of steam per hour per horsepower (an average condition), making a total of 12,000 pounds of water per hour. Five percent of moisture would be 600 pounds. At 850 B. T. U. this would be 510,000 B. T. U. Assuming that the coal runs an average of 8,000 B. T. U. per pound and the efficiency of the boiler is an average of 65 percent, there is a net 5,200 B. T. U. delivered to the water for each pound of coal, therefore 510,000 divided by 5,200 gives about 980 pounds of coal going to waste per hour because of the moisture in the steam. A good steam separator will remove the most of the moisture; but this is not economy, because it does not restore the heat which has been lost by the condensation of the steam.

The only true economy is to prevent, so far as possible, this loss of heat by lagging the boiler and steam pipes with the best lagging that can be procured. The lagging must be of such quality and quantity that the outside of the covering feels only slightly warm to the hand. Money is well spent on good lagging, as it is one of the truest and most profitable of economies.

The greatest value of superheated steam is that it practically eliminates the moisture. Saturated steam is at the same temperature as the water from which it came, but superheated steam is hotter than the water from which it came at that particular pressure and can, therefore, cool down a little before it condenses. Saturated steam, on the other hand, condenses with the slightest cooling down. This elimination of moisture does not represent a real saving, though, because the heat is radiated slightly faster because of the higher temperature of superheated steam. Superheaters usually use waste heat from the stack, which represents a clear gain thermally, but they often cause practical troubles, as already noted.

All liquids have different boiling points at different pressures. They also have different pressures for various boiling points. For water at 212 degrees Fahr., the vapor pressure is 14.7 pounds per square inch (one atmosphere). For pressures less than this, the temperatures, etc., are as shown in the table on page 388.

All of these data, as well as that for latent heat, may be secured from the steam tables which are in all technical engineer's pocket books, such as Seaton's, Kent's, etc.

Since liquids have boiling points which vary with coinciding pressures, it follows that if the steam is not superheated, it is at the temperature due to the coinciding pressure. Conversely, if the pressure drops, the steam is left at the original temperature, which renders it superheated relative to the water, because it is at a higher temperature than the water. Dropping of the pressure and expansion are the same thing. If the expansion takes place while the steam is doing work, as in an engine cylinder, the temperature drops with the pressure, in accordance with the steam tables, but if the expansion is made

Inches of Mercury.	Pressure in Pounds Per Square Inch Above Zero.	Temperature—Degrees Fahrenheit.
29.74	.089	32
29.67	.122	40
29.56	.176	50
29.40	.254	60
29.19	.359	70
28.90	.502	80
28.51	.692	90
28.00	.943	100
27.88	1	102.1
25.85	2	126.3
23.83	3	141.6
21.78	4	153.1
19.74	5	162.3
17.70	6	170.1
15.67	7	176.9
13.63	8	182.9
11.60	9	188.3
9.56	10	193.2
7.52	11	197.8
5.49	12	202.0
3.45	13	205.9
1.41	14	209.6
0.00	15	212.
Gage Pressure in Pounds	And for Pressures Above Atmosphere	
100.3	115	337.8
200.3	215	393.6
335.3	350	432

without the steam doing work, as in the receiver of an engine where the steam drops in pressure from the exhaust of the preceding cylinder, or through a reducing valve on the boiler, or through a half-closed throttle, the reduction in pressure leaves the steam at its original temperature, above the temperature due to the pressure, as given in the steam tables, and the steam is superheated. It has not been heated up, the pressure has simply dropped away from it. Not only is the steam left in a superheated state, but all of the moisture is immediately evaporated because of the reduced pressure. This is why an engine will stop knocking from water in the steam if the throttle be partially closed.

One of the least known and most prolific causes of a boiler priming is the improper placing of the feed water inlet to the boiler. For the water to be converted to steam requires a certain element of time. If the inlet be so placed that the water follows a normal route of circulation before coming to the surface, it will give no trouble; but if the inlet be placed at a point where normal circulation terminates and the water is converted to steam, much cold water will be carried away with the steam, giving the impression that the boilers are priming. In a Scotch boiler the water usually sinks on the sides and rises in the center. The writer has seen feed valves connected between the furnaces, and even over the furnaces, and in each case the boiler "primed" badly.

The next letter will take up the subject of the engine, treating it analytically from the standpoint maintained throughout this serial, of analyzing existing plants, with a view to increasing the earning power of the ship, rather than any attempt to write a text-book on marine engineering. After a consideration of the power plant in each of its departments and their economic relation to the whole, it is our hope (with the permission of the editor) to write a chapter or two upon auxiliary machinery and its relation to the earning power of a ship, cargo machinery, floating repair shops, and the construction of docks, from the standpoint of the efficiency and earning power of a steamship line.

E. N. Percy.

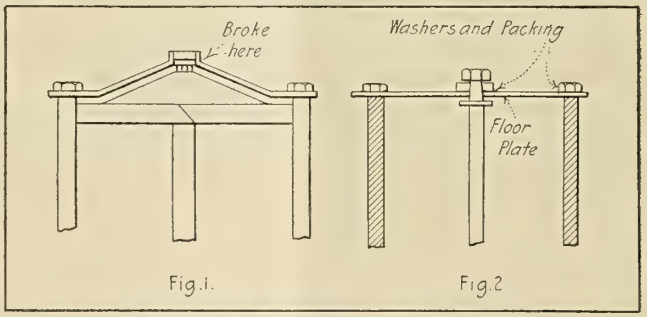
Losses to Merchant Shipping.—According to data compiled by the *Journal of Commerce*, the total losses to merchant shipping, arising from the war up to June 1 have been about 1,272 vessels of more than 2,585,362 gross tons. Approximately 57 merchant vessels of all types, having an aggregate gross tonnage of about 116,724, were destroyed during the month of May.

Emergency Repair to Circulating Engine

During a trip in some heavy weather the nut on the top of the high pressure piston rod broke loose and backed off, due to the fact that there was no cotter pin through it. The nut backed off enough to punch a hole through the cast iron cylinder head, putting the engine out of commission. As there are usually no other means aboard most ships to circulate water through the condensers, except by the main circulating pumps, the temporary repair that we devised may be a handy piece of information for some other fellow in a similar fix.

This accident happened when we had some 1,400 miles to go. The weather was bad for two days and the barometer was still going down, so I considered that a temporary repair was urgent in order to keep the engines running at slow speed.

The cylinder head was cone shaped, as shown in Fig. 1, and the clearances between it and the piston small. When



Sketch of Repairs to Cylinder Head

the nut backed off, it punched the top out, as shown by the arrow in Fig. 1.

The broken head was taken off, and the piston removed from the rod. The crank brass of this engine was taken off and the piston rod, connecting rod and crosshead were then blocked up hard and secure. Then a piece of floor plate of ribbed steel 9/16 inch thick was cut with an air hammer to a rough circle of the diameter of the head, and stud holes drilled, and also a hole in the center to fit over the piston rod, as shown. Gaskets were made and grummets of asbestos packing were put around the studs and piston rod, and with washers on top of the grummets these were all set up tight. As the steam was turned in slowly, each nut was set up again and the engine was jacked so that the low pressure was just over the center.

After looking things over, steam was admitted to the engine and she started off very nicely, running satisfactorily until we were able to repair the broken head sufficiently to enable it being replaced. This was accomplished by forming a patch in the forge to fit over the break and securing this patch on the cylinder head with screws and iron cement. C. H. W.

Sale of Chilean Ships to be Prohibited.—Dispatches from Valparaiso indicate that the Chilean Congress, recently assembled, will pass an act prohibiting the sale of Chilean merchant ships to foreigners without the consent of the Chilean government. During the past sixteen months similar legislation has been enacted in the following countries: Great Britain, Belgium, Italy, Austria-Hungary, Denmark, Germany, Russia, France, Greece, Norway, Brazil, Spain, Holland and Sweden.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT *

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

Size of Equalizer Leads

Q.—Our present plant consists of a 10-kilowatt. 125-volt compound generator. A second unit, the exact duplicate of this is to be installed to operate in parallel with the first. Can you tell me how large an equalizer bus I should use? E. E.

A.—The equalizer leads may well be of the same size as the main generator leads. Practice varies somewhat in this matter, the range of size being from 0.5 to 1.0 times the sectional area of the leads to the generator.

Size of Propeller for Motor Boat

Q.—Will you please tell me what size propeller I should use for a motor boat of the following dimensions: Length on waterline, 34 feet 4 inches; breadth, 6 feet; displacement, 5,200 pounds; engine, six-cylinder, 6¼-inch by 6½-inch Niagara, 100 brake horsepower at 950 revolutions per minute. The hull is of the speed boat type and I hope to get 20 miles per hour out of her. M. B.

A.—For the horsepower given the speed is a reasonable one and a proper propeller would be 24 inches diameter by 26 inches pitch, three blades.

Direct and Indirect Valves

Q.—Isn't the use of the terms "direct" and "indirect" a recent innovation in describing engine valves? I do not remember having heard of it when I studied valves in school. Will you please tell me what they mean?

A.—A valve in which the admission of steam is controlled by the outside lap is called "direct," one taking steam on the inside is called "indirect." These terms have been in use for some time, though many of the earlier books on valve gears do not mention them.

Variation of Turning Moment in Propeller Shaft

Q.—Can you tell me, in the case of a reciprocating engine, where it is well known that the turning moment acting on the propeller shaft is not uniform, if the amount of the variation is well known and what it would be for a compound engine of about 800 indicated horsepower which runs at 78 revolutions per minute? I can figure the mean turning moment due to the indicated horsepower, but what I want is, what force to use in the calculation for line shafting, etc.? S. H. P.

A.—About 40 percent for a compound engine with the cranks at 90 degrees is a reasonable figure and somewhat less, say 35 percent for a triple with cranks at 120 degrees. These figures are fairly well determined and are in common use for design. The figures quoted are the excess of the *maximum* over the *mean* torque or rotative effect.

Classification of Terry Turbine

Q.—In what classification of turbines would you place the Terry, and would its velocity diagram be similar to any of the other commonly known makes? T. T.

A.—The Terry turbine is an impulse turbine of the so-called velocity compounded type, that is, a high initial velocity is given to the steam by one expansion or pressure drop and this velocity is partially abstracted in the adjacent moving vanes with additional velocity abstractions by passing through additional moving vanes or as in the case of the Terry a repeated passing through the same vanes. The velocity diagram simulates very closely that of the Curtis, velocity compounded, single pressure stage, turbine.

Insulating Materials for Cold Storage Compartments

Q.—We are planning to insulate a small compartment for the carriage of cold-storage products, and I wondered if you could tell me whether there have been engineering tests to determine the best substances for thermal insulation. What do you consider as the best taking account of the severe wear and tear that is inevitable in an installation of this sort? I should greatly appreciate any help that you could give me in making a decision. R. E.

A.—Of the commercially available products for insulation of refrigerated spaces cork and balsa wood rank highest from the thermal point of view, and these have been selected from the others by extensive tests reported from time to time in the engineering journals. Cork is used both in the ground form and in blocks and the balsa wood usually in boards or blocks.

Increasing Voltage of Generator Set

Q.—We have a 10 kilowatt generator direct-connected to a small two-cylinder steam engine which operates at constant speed. When the set is running under full load the lights which are at the ends of long leads are dim. I attribute this to a reduction in voltage. Will you kindly tell me if this is so, and if so what I can do to raise it, and will there be any likelihood of getting into other trouble by raising the voltage? V. T.

A.—The trouble is due to a reduction in voltage in the long leads, which may be remedied as follows with no danger of other trouble arising as a consequence of the changes:

(a) If your generator is compound wound and at present equipped with a series shunt, the addition of resistance to this series shunt will increase the voltage of the generator under load.

(b) A similar result can be obtained by adjusting the governor of the engine to give a slightly higher speed.

(c) If it is a shunt generator a few turns of series winding per pole will probably help boost the voltage, but this may be difficult to do if limited facilities only are available.

Trouble with Feed Pump

Q.—Can you suggest anything that would be likely to make a feed pump, which had worked satisfactorily for years, suddenly start jumping and persist in this despite all coaxing and care. The pump is a vertical, simplex, Worthington, used for boiler feed and discharging at about 190 pounds. It is eight years old, is in good mechanical adjustment and operates well except for this recent and persistent jumping forward on the discharge stroke. Do you know of any good book which describes the common commercial pumps from the operator's point of view? P. M.

A.—There are many possible explanations; one that suggests itself is that the erratic action may be due to air leaking in during the suction stroke which is compressed during the first part of the discharge stroke. Air may leak in through the stuffing-box, blow-holes in castings, gaskets, drains, etc. If the pump will not take a suction when starting, the valves may have been leaking from the feed line and the pump may be vapor bound, in which case turn a hose on it to cool it off. Descriptive booklets issued by the makers probably give the most reliable descriptions and the makers are glad to send them free on request. For a splendid description of com-

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mon operating troubles and their remedies see an article that appeared in the *Journal of the American Society of Naval Engineers*, November, 1915, entitled "Notes on Pumps," by S. M. Robinson, which will probably give you the information desired.

Ratio of Turbine Reduction Gearing

Q.—What is the ratio of the main turbine shaft to the driven shaft revolutions in a De Laval single-stage turbine-driven electric generating unit? The name plate gives the revolutions per minute of the electric generator as 2,000. T. E. G.

A.—Probably 10 to 1, as this a common ratio for De Laval units of small size.

Ljungstrom Turbine

Q.—Will you please tell me whether the Ljungstrom turbine is of the impulse or reaction type? I have been unable to find a definite statement concerning this point and would greatly appreciate an answer. Turbine.

A.—The Ljungstrom turbine is a radial flow turbine and embodies both principles, impulse and reaction, as there is a drop in pressure accompanied by an increase of velocity through each successive set of vanes, and the velocity so generated is used in the following set as an impulse. It probably falls most nearly into the "reaction" class if we accept the loose use of that term which classes the Parsons type as a "reaction" unit.

Rate of Evaporation for Scotch and Watertube Boilers

Q.—What is reasonably good actual evaporation for a Scotch boiler generating steam at 180 pounds and a watertube boiler generating steam at 250 pounds? Can a feed pump be relied upon to measure the water fed to a boiler if we count strokes and know the pump dimensions? S. O. L.

A.—Actual evaporation of from 9 to 10 pounds per pound of coal of about 14,000 B. T. U. calorific value and natural draft is good for the Scotch boiler, and 9 to 10 pounds per pound of steam is good for general operation of the watertube boiler with moderate drafts. The feed pump is an erratic and inaccurate meter for the feed water, as the length of stroke varies and the slip varies in a given pump. Moreover, estimates of slip depend usually upon tests upon other pumps than the one in use and mechanical adjustment affects this factor enormously.

Test for Steam Consumption of Feed Pump

Q.—I want to test out the steam consumption of a feed pump here without going too elaborately into it and without any more expense than necessary. I have thought that I might break the exhaust line and discharge directly into a barrel of cold water, which I could weigh before and after. Do you think this would give me a reasonable estimate of it? Assist. Eng.

A.—If the feed pump is of moderate size, it is probable that the barrel of cold water will have insufficient condensing capacity to give reasonable accuracy. A large barrel will hold 55 gallons, which would weigh about 460 pounds of fresh water and 470 pounds of salt. If this were drawn at a temperature of 50 degrees Fahrenheit and we would condense a temperature of 180 degrees Fahrenheit, it would absorb approximately $180 - 50 = 130$ B. T. U. per pound of water, or a total of $470 \times 130 = 61{,}000$ B. T. U. The heat given up by one pound of steam at atmospheric pressure (with a quality assumed of .90) is approximately the heat contents of the steam from the steam charts, minus the mean heat of the condensate, or $1{,}052 - 83 = 969$ B. T. U., so that the barrel of water would condense only $61{,}000 \div 969 = 63$ pounds of steam, which would be a very short run for an average pump, and the result would be open to question to possibly 10 percent with ordinary weighing. A feed pump 7 inches steam by 4 inches water by 10 inches stroke uses about 500 pounds per hour, and if a run as short as five minutes can be considered typical, and the accuracy above quoted is sufficient, the method will do.

Comparison of Engine Performance

Q.—If we have two triple expansion engines of about the same indicated horsepower and revolutions per minute, but one working on a boiler pressure of 260 pounds absolute and the other on a boiler pressure of 180 pounds absolute, is it fair to compare steam consumption, dry steam, or even B. T. U.'s per indicated horsepower per hour, as measures of efficiency of design and performance? It doesn't seem to me that it is, yet I do not know how to throw them on a basis which permits an equitable comparison. I should be greatly obliged if you would take up this point and give suggestions for doing it—provided, of course, that I am correct in my attitude as to the unfairness of comparison when the boiler pressures are so widely divergent. T. E.

A.—A comparison of engines on the basis of actual steam consumption given in pounds of steam used per indicated horsepower per hour is of no value unless qualified by a description of the "pound of steam," as the heat contents (which is really the energy available) differs enormously for a pound of steam at any given pressure dependent upon whether it is wet, dry, or superheated. The quotation of performance in terms of pounds of dry steam or B. T. U. per indicated horsepower per hour avoids this objection, and is correct as a thermal comparison or as a comparison of actual energy used to produce one indicated horsepower.

None of these, however, takes any cognizance of variations in external conditions or of the nearness to which the given unit approaches perfection in its field. Nearly every conception in engineering is relative, and a true comparison is properly one which takes account of the limitations which external conditions impose, therefore one of the best comparisons of engines is the ratio of the consumption in thermal units of the *ideal*, a Rankine engine, to that of the *actual* engine. This is variously called commercial efficiency, efficiency of performance, etc., and simply means the percentage of the ideal steam engine performance that the one under discussion has achieved. The Rankine, or ideal, engine would transform all the heat available by an adiabatic drop from the upper to the lower pressure into work and the expression for its efficiency is

$$\frac{H_1 - H_2}{H_1 - q_2}$$

where H_1 = heat contents at upper pressure.
H_2 = heat contents at lower pressure.
q_2 = heat contents of the liquid at lower pressure.

To illustrate by the case you cite of two engines of same general characteristics, but one operating on a cycle from 260 pounds absolute to, say, 2 pounds absolute, and the other from 180 pounds absolute to 2 pounds, using dry saturated steam at the upper pressure, the Rankine efficiency of the first is

$$\frac{1202 - 886}{1202 - 94} = 28.6 \text{ percent}$$

and of the second is

$$\frac{1195 - 904}{1195 - 94} = 26.4 \text{ percent.}$$

Therefore, for a fair comparison of performance, the lower pressure engine should be credited with this difference. That is, the consumption of the higher pressure engine should be augmented by

$$\frac{28.6 - 26.4}{28.6} = 7.7 \text{ percent}$$

to compare equitably the achievements of the designer, builder and operator in the final performance. Stated differently, a steam consumption of 14 *pounds* of dry steam per indicated horsepower per hour for the engine using steam at 260 pounds pressure, and a consumption of $14 \times 1.077 = 15$ *pounds* of dry steam per indicated horsepower per hour for the engine using steam at 180 pounds are exactly equal attainments to the ideal. Therefore it is desirable to reduce engine tests to a common cyclical efficiency before analyzing for commercial efficiency.

Shipbuilding and General Marine News

Contracts for New Ships—Marine Terminal Improvements—Recent Launchings—Improved Appliances—Personal Items

At present the United States for the first time in over half a century is not only building more merchant shipping than any other country, but the American output for the year 1916 will probably exceed that of all the rest of the world, says a recent report from the Department of Commerce. The report further states:

The most complete records of the world's shipbuilding, uniform for a period of years, are those published by Lloyd's Register, showing merchant vessels over 100 gross tons launched each calendar year, not including vessels built for rivers, barges, and other unrigged craft. For this reason Lloyd's figures are somewhat less than the Government returns for the United States, the Netherlands, Germany, and other countries with considerable river and canal navigation. Lloyd's returns for the calendar years 1912, 1913, 1914 and 1915 are printed below as the best measure of the effect of the European war on merchant shipbuilding, although changes in the case of the United States are not attributable to that cause. The world's output of merchant shipping during the calendar year 1913 was the largest recorded, and under normal conditions probably would not have been fully maintained for two or three years following. The returns below for 1914 closed with the end of July so far as Germany and Austria are concerned, as those countries have issued no shipping reports since the outbreak of the war.

Merchant Vessels Launched

The following table gives the gross tonnage of merchant vessels of 100 gross tons or over launched in the world during the calendar years 1912 to 1915, inclusive:

Where Built.	1912.		1913.		1914.		1915.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
United Kingdom.	712	1,738,514	688	1,932,153	656	1,683,553	327	650,919
British Colonies	84	34,790	91	48,339	80	47,534	31	22,014
Austria-Hungary	12	38,821	17	61,757	11	*a*34,335	(*b*)	(*b*)
Denmark	22	26,103	31	40,932	25	32,815	23	45,198
France	80	110,734	89	176,095	33	114,052	6	25,402
Germany	165	375,317	162	465,226	89	*a*387,192	(*b*)	(*b*)
Italy	27	25,196	38	50,356	47	42,981	30	22,132
Japan	168	57,755	152	64,664	32	85,861	26	49,408
Netherlands	112	99,439	95	104,296	130	118,153	120	113,075
Norway	89	50,255	74	50,637	61	54,204	59	62,070
Sweden	22	13,968	25	18,524	26	15,163	27	20,319
United States:								
Coast	144	194,273	182	228,232	84	162,937	76	157,167
Great Lakes	30	89,950	23	48,216	10	37,825	8	20,293
Other countries	52	46,654	83	43,455	35	*a*36,148	10	*a*13,641
Total	1719	2,901,769	1750	3,332,882	1319	*a*2,852,753	743	*a*1,201,638

a Returns not complete. *b* Returns not available.

Effect of War on Shipbuilding

The first five months of the war did not seriously affect the world's launching of merchant ships, outside of Belgium, France and Germany, although deliveries late in 1914 began to be slow in British yards. In 1914 the United States launched only 200,762 gross tons, compared with 276,448 gross tons in 1913, but the decrease was not a result of the war. The world's total in 1914, even with the Central Powers excluded for five months, was only 480,000 tons less than the world's maximum in 1913 and was above the recent average annual output.

The belligerent powers, which in 1913 launched 2,798,580 gross tons of merchant ships, launched only 769,875 gross tons in 1915. The neutral powers, outside of the United States, in 1913 launched 257,844 gross tons, and in 1915 launched 254,303 gross tons. Local causes led to a further reduction in the American output from 276,448 tons in 1913 to 177,460 tons in 1915. The total decline in the world's shipbuilding for 1914 and 1915, both compared with 1913, was 1,438 ships of 2,611,373 gross tons. To these totals should now be added the decreased output in shipyards for the first six months of 1916, which the Bureau of Navigation states would bring the total since the outbreak of the war in August, 1914, up to 3,500,000 gross tons, notwithstanding the present activity of American, Japanese and Dutch yards. The loss to international commerce through the decline in shipbuilding thus has been greater than the loss through the actual destruction of shipping, although the latter has fixed the world's attention because of the submarine attacks on passenger steamships Reports compiled by the New York *Journal of Commerce* (July 5, 1916) show that 1,346 ships of 2,713,996 gross tons were destroyed from the outbreak of the war to June 30, 1916.

Activity in the United States

Late in 1915 and early in 1916 belief that the European war would last three years led to an exceptional development of shipbuilding by the maritime powers not actively engaged in war. In the first six months of 1916 the United States launched and put into operation 192 ships of 228,016 gross tons (each over 100 tons)—more than the entire year's output for 1914 or 1915. On July 1, 1916, private American shipyards were building or had on order 385 steel merchant ships of 1,225,784 gross tons. The builders' returns indicate that of this tonnage 159 ships of 444,090 gross tons will be launched before December 31, 1916, thus indicating a total output by the United States for the twelve months of 351 steel ships of 672,106 gross tons. Various causes retard shipbuilding, especially in times of high pressure, and the output of steel ship tonnage during the current six months of 1916 may fall short of present indications. Wooden ships, however, not included in the Bureau of Navigation's monthly returns, will help to make good any shortage, as wooden ship building has revived considerably under the pressure of the times.

Shipbuilding in Japan and the Netherlands

The shipyards of Japan, according to Commercial Attaché Arnold's recent report, are fully occupied with work for two years, and have reluctantly been obliged to decline foreign orders in order to supply their own shipowners. The ships building for delivery this year number 50 of 189,450 gross tons, which will be more than double Japan's largest output in 1914. Japanese builders have contracts for 104 ships of 464,370 gross tons to be delivered in 1916, 1917 and 1918, the Osaka yard contracting to deliver 35 of 162,400 tons. Japan, however, is obliged to import steel and began negotiations in the United States in January, which have been carried out successfully and extended considerably the market for American steel products.

The shipyards of the Netherlands, according to recent reports of American officers, have contracted to build merchant ships at extraordinary prices practically up to their capacity for 1916, 1917, and into 1918. Ships thus building or ordered late in 1915 were reported at 71, of 251,750 gross tons. Delivery, however, seems to be somewhat slow, as during the first three months of 1916 only seven new ships, of 15,349 gross tons, were added to the Dutch seagoing merchant fleet, while in the same period the *Tubantia* (13,910 tons), the *Palembang* (6,673 tons), and others were sunk by submarines and drifting mines.

Output in Norway, United Kingdom, France, Italy and Germany

Norway's output of 85,000 tons in 1915 was the largest recorded and will doubtless be exceeded this year, as over a year ago Norwegians began to place large orders in American yards, some with a view to subsequent sale to Americans or others.

On March 31, 1916, the shipyards of the United Kingdom had under actual construction, according to Lloyd's' Register, 423 steel steamships, of 1,423,335 gross tons, many of which for some months have been nearly completed, but await materials. The dates of launch and completion in British yards are uncertain so long as yards are employed fully on naval construction and turning out war munitions for the allies. During the first three months of 1916 British yards launched only 69 steel steamers, of 80,561 gross tons.

French shipyards also are fully employed on naval construction and the manufacture of munitions, and French shipowners have made inquiries for tonnage from American builders. There is in France a considerable tonnage of merchant steamships partly built.

In December, 1915, the Italian shipyards had 12 steel steamships, of 82,482 gross tons, under construction, but the probable date of completion is not known. There are no returns from Austria-Hungary, and presumably shipbuilding has ceased under the Italian blockade of Trieste and Fiume.

Since the outbreak of the war Germany has printed no returns, and is supposed to be engaged in building submarines and other naval construction, repair, and munitions work. In December, 1913, the Germanischer Lloyd report showed 499 merchant vessels, of 906,851 gross tons, including river boats, canal boats, lighters, etc., were building in German yards, of which up to July 30, 1914, 89, of 387,192 gross tons, had been launched, so that in August, 1914, about 410 vessels, of 520,000 gross tons, were building or ordered in German yards. Cabled statements to the United States in July, 1916, from Hamburg-American and North German Lloyd authorities indicate that such merchant work as Germany has done since the outbreak of the war has been, with few exceptions, on the ships ordered late in 1913 and early in 1914.

Increase in American Shipbuilding During the Year

The Bureau of Navigation, Department of Commerce, reports 1,030 vessels of 347,847 gross tons were built in the United States and officially numbered during the fiscal year ended June 30, 1916, compared with 1,266 vessels of 215,711 gross tons during the fiscal year ended June 30, 1915.

The seaboard yards have built 35 large steel merchant steamers aggregating 191,859 gross tons, the largest merchant steel output in their history. Of these, 21 steamers are each over 5,000 gross tons, the largest being the steamship *H. H. Rogers,* of 10,050 gross tons, and 14 are between 3,000 and 5,000 gross tons each. The Newport News Shipbuilding & Dry Dock Company, Newport News, Va., built six of 40,329 gross; the Maryland Steel Company, Sparrows Point, Md., eight of 35,665 gross; the Union Iron Works, San Francisco, Cal., five of 32,665 gross; the New York Shipbuilding Company, Camden, N. J., seven of 32,164 gross; and the Fore River Shipbuilding Company, Quincy, Mass., four of 24,932 gross. The Newport News, Camden and Quincy yards were also engaged in naval construction.

Of these steel ocean steamers, twenty-four of 138,858 gross tons have been registered for foreign trade, eight of 34,386 gross tons enrolled for the coasting trade, one, the steamship *Pacific,* of 6,034 gross tons, was sold to Norwegians, and up to June 30 the two remaining had not been documented.

Of the relatively small output of the Great Lakes, eight vessels of 14,775 gross tons are each under 2,500 tons, built for the ocean trade, of which four are for foreign trade and one (*Morris Adler,* 2,481 gross) has been sold to Norwegians.

Following is the detailed statement according to material and power (gasoline included under steam) for the fiscal year ended June 30, 1916, compared with the previous fiscal year.

	Number.	1916, Gross Tons.	Number.	1915, Gross Tons.
Wood:				
Sailing	47	16,087	50	7,241
Steam	594	18,781	743	27,082
Unrigged	285	62,844	357	60,188
Total	926	97,712	1,150	94,511
Metal:				
Sailing	....	.....	1	27
Steam	86	245,212	68	120,385
Unrigged	18	4,923	7	788
Total	104	250,135	76	121,200
Totals:				
Sailing	47	16,087	51	7,268
Steam	680	263,993	811	147,467
Unrigged	303	67,767	364	60,976
Grand total	1,030	347,847	1,266	215,711

Progress of American Shipbuilding

Steel merchant vessels building or under contract to be built in private American shipyards at the beginning of the new fiscal year, July 1, 1916, according to builders' returns to the Bureau of Navigation, Department of Commerce, numbered 385 of 1,225,784 gross tons. The Senate Naval Committee on June 30 reported the naval appropriation bill, which has later been passed by the Senate, providing the largest naval building program in our history. The new battleships, battle cruisers, scout cruisers, and other types of warships and auxiliaries number 157 of approximately 855,000 tons displacement, to be built at an estimated cost of $588,000,000. Of these, 66 of about 382,000 tons displacement are to be begun as soon as practicable, and the remainder before July 1, 1919. For comparison, on June 30, 1914, British shipyards were building 90 warships of 592,545 tons displacement, of which 76 of 458,175 tons displacement were building at private yards.

Growth During Twelve Months

The usual growth of steel merchant shipbuilding in the United States during the past twelve months is shown by the following summery of (*a*) steel merchant ships building or under contract to be built in private American shipyards on July 1, 1915, and on July 1, 1916, and on the first day of the past five months, (*b*) new contracts for steel merchant ships entered into during the past five months, and (*c*) steel merchant ships built in the United States and officially numbered during those months.

Period.	Built or Under Contract.		New Contracts.		Vessels Completed	
	Number	Gross Tons	Number	Gross Tons	Number	Gross Tons
July 1, 1915..	76	310,089	....	.....	....	.....
Feb. 1, 1916..	230	901,371	20	61,136	6	31,329
Mar. 1, 1916..	244	945,798	107	151,296	5	23,394
Apr. 1, 1916..	360	1,037,856	20	51,011	6	12,915
May 1, 1916..	368	1,129,014	20	81,470	13	53,840
June 1, 1916..	372	1,147,534	39	114,530	10	39,940
July 1, 1916..	385	1,225,784	....	.....	....	.....
Total....	....	.....	206	459,443	40	161,418

For comparison, on March 31, 1916, private shipyards in the United Kingdom had under actual construction 423 steel merchant ships of 1,423,335 gross tons. As British shipyards are almost wholly engaged in naval construction and the manufacture of war munitions for the allies, merchant ship construction is slow, and during the first three months of 1916, only 67 steel steamers of 80,161 gross tons were launched. For further comparison, the entire world during the calendar year 1915, according to Lloyd's Register, launched 743 merchant ships of 1,201,638 gross tons, of which 84 of 177,460 gross tons were launched in the United States.

Two Year's Work

The report also shows the distribution of steel merchant shipbuilding among the private shipyards of the United States and, separately, the number and gross tonnage of the ships building or under contract which the builders expect to launch during the current fiscal year, ending June 30, 1917, and those which will not be launched before the fiscal year ending June 30, 1918. These dates are subject to the usual allowances for delays due to the several causes which affect steel industries. The urgency of the naval construction program may also prove a factor in the situation. Barring delays, builders expect to launch 327 steel ships of 927,893 gross tons during the current fiscal year and 58 ships of 297,891 gross tons during the following fiscal year.

Shipbuilding Contracts

Contracts are in suspense for about fifty steamships for 1918 delivery. They are temporarily held up while awaiting agreement as to prices and time of delivery of the necessary steel plates and shapes.

The Wm. Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has received a contract from the New York & Cuba Mail Steamship Company (Ward Line), New York, to build two passenger and freight steamers of 12,000 tons displacement each.

The American Shipbuilding Company, Cleveland, Ohio, has received a contract to build five large freight vessels for 1917 delivery. Two of these are for M. A. Hanna & Company, Cleveland, Ohio.

The Pusey & Jones Company,, Wilmington, Del., is reported to have received orders for twelve additional ships. Six are to be 225 feet long and six are to be 300 feet in length. There are already eight vessels under construction in this yard.

The Seattle Construction & Dry Dock Company, Seattle, Wash., has received a contract from the New York & Cuba

Mail Steamship Company to build two freight steamers of 6,000 tons displacement each.

The Skinner & Eddy Corporation, Seattle, Wash., has received a contract from the Standard Oil Company, San Francisco, Cal., to build two 430-foot oil tanker steamships, to be equipped with General Electric turbines.

It is reported that the Willamette Iron & Steel Works and the Northwest Steel Company, Portland, Ore., have received a contract to build another steel steamship, to be a duplicate of the four already under contract for Capt. C. Hannevig, New York.

The St. Helens Shipbuilding Company, St. Helens, Ore., has received a contract from the California & Oregon Lumber Company, Brookings, Cal., to build a large lumber schooner to be fitted with Bolinder oil engines.

M. M. Davis & Sons, Solomons Island, Md., have received a contract to build a 200-foot wooden freight steamer for the Baltimore & Carolina Steamship Company, Baltimore, Md.

The Harlan & Hollingsworth Corporation, Wilmington, Del., is building a steel freight ship for the Baltimore & Carolina Steamship Company.

The Ellicott Machine Corporation, Baltimore, Md., is building three steel tugs.

The Merrill-Stevens Company, Jacksonville, Fla., has received a contract from the Boston Molasses Company, Boston, Mass., to build a 139-foot steel steam-driven barge.

The Merrill-Stevens Company is building two barges for the Cuba Distilling Company, Havana, Cuba.

Richard T. Green Company, Chelsea, Mass., is building a four-masted schooner 200 feet long.

George Lawley & Sons Corporation, Neponset, Mass., has received a contract from the Navy Department, Washington, D. C., to build a gasolene patrol boat 45 feet long.

The Luders Marine Construction Company, Stamford, Conn., has a contract from the Navy Department to build a 65-foot motor patrol boat.

The Hanlon Shipyard, Oakland, Cal., has a contract from the Western Fuel Company, San Francisco, Cal., to build two barges with a capacity of 3,500 tons each.

A. C. Brown & Son, Staten Island, N. Y., have a contract to build a wooden steam lighter for the Old Dominion Steamship Company, New York.

A. C. Brown & Son have received a contract to build a 91-foot wooden tug for the Gillen Lighterage Company, New York.

The John Wilson Shipyard, Seattle, Wash., has received a contract from the Tacoma Dredging Company for a 110-foot dredger, to cost $70,000.

The Seattle Construction & Dry Dock Company, Seattle, Wash., has recently secured a contract for two new steel freighters for foreign service.

The Great Lakes Engineering Works, Ashtabula, has recently received a contract from Mr. Aug. Stephanson, Christiania, Norway, for a 4,150 ton deadweight cargo steamer. The vessel is 253 feet long by 43 feet 5 inches beam and 27 feet 5 inches depth, and will cost $450,000.

The American Shipbuilding Company, Cleveland, Ohio, has recently received orders for four full-canal-size ships for salt water service, for delivery during the first half of 1917.

The Seaborn Company, Tacoma, Wash., is starting work on two lumber vessels, both to be equipped with oil or gas engines.

The Beaumont Shipyard Corporation, Beaumont, Texas, has received an order from the Orange Maritime Corporation for the construction of a three-masted schooner, 168 feet long by 36 feet 6 inches beam by 15 feet depth, with a carrying capacity of 700,000 feet of lumber, or about 1,500 tons. The vessel is intended for the West Indian trade.

The Robins Dry Dock & Repair Company, Erie Basin, Brooklyn, N. Y., recently lengthened the freight steamer *George E. Warren*, of Boston, 52 feet, adding about 1,000 tons to her carrying capacity.

The Union Iron Works, San Francisco, Cal., recently completed the lumber steamer *Daisy Matthews* at their Oakland plant. This vessel will have a carrying capacity of a million feet of lumber and her first voyage will be to Gray's Harbor, Wash.

The General Electric Company, Schenectady, N. Y., has received a contract from the United States Navy Department for the construction of propelling machinery for the scout cruiser *Salem*.

The Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., has received a contract from the United States Navy Department for propelling machinery for two naval destroyers.

The American Bridge Company, a subsidiary of the United States Steel Corporation, recently received orders for the construction of seven car floats or barges for the Lehigh Valley Railroad, to be used in New York harbor.

The Spedden Shipbuilding Company, Baltimore, Md., has laid the keel for a tugboat for the Northern Transportation Company, of Baltimore. The new tug will be 150 feet long overall and will have a bunker capacity of 330 tons.

The Spedden Shipbuilding Company, Baltimore, Md., is rebuilding the sidewheel steamers *Maryland* and *Capital City* into coastwise barges.

A steel oil tank barge was recently launched from the yards of the Spedden Shipbuilding Company, Baltimore, Md., for the Standard Oil Company for use in Norfolk harbor. The barge is 64 feet 3 inches long, 16 feet 8 inches beam and 5 feet deep, with four oil compartments.

The Newport News Shipbuilding & Dry Dock Company, Newport News, Va., was the successful bidder for making permanent repairs to the Dutch steamer *Willem van Driel, Jr.*, recently badly damaged by fire.

Shipyard News

The Fore River Shipbuilding Corporation, Quincy, Mass., has recently completed what is said to be the largest ship plate and angle shop in the world. The building is of brick and steel construction, 769 feet long by 188 feet wide and 60 feet high, covering an area of 3¼ acres. The second story of the building contains the mold loft, 93 feet by 605 feet, a sheet metal working shop and storage space.

At the Maryland Steel Company's plant, Sparrows Point, Md., large additions are soon to be made costing upwards of $30,000,000. Although details are temporarily withheld, it is understood that the marine department of the plant will be materially enlarged.

The Willamette Iron & Steel Works, Portland, Ore., is about to erect a boiler shop costing $12,000.

The Western Dry Dock & Shipbuilding Company, Port Arthur, Ont., is building a pattern and electrical shop, costing $25,000, to replace one recently destroyed by fire.

The Sydney Foundry & Machine Company is proposing to build dry docks and a ship repairing plant at Sydney, Nova Scotia.

The Seattle Construction & Dry Dock Company, Seattle, Wash., recently taken over by the Todd Shipyards Corporation, New York, will be greatly enlarged and improved by the addition of five new shipbuilding ways and a new steel floating dry dock and the enlargement of the present dry dock.

The Winslow Marine Railway & Shipbuilding Company, Seattle, Wash., has recently been organized with a capital stock of $600,000 and has taken over the shipbuilding plant of the Hall Bros.' Marine Railway & Shipbuilding Company, Winslow, Wash. The company will engage in wooden shipbuilding and ship repairing. C. C. Lacey, of Seattle, Wash., formerly marine superintendent of the Great Northern Steamship Company, will be manager of the new company.

The Chester Shipbuilding Company, Ltd., Chester, Pa., which bought the late John Roach Shipyard a year and a half ago, and now has orders for fourteen vessels, is planning the construction of two additional shipways, which will bring the total number at the yard up to seven, and also the construction of a 40 by 200 foot fitting-up wharf.

The New York Shipbuilding Company, Camden, N. J., is building a one-story extension to its machine shop, 131 feet by 169 feet.

It is reported that the Union Iron Works, San Francisco, Cal., is planning to spend about $1,000,000 in enlarging the nearby shipyard which it has recently purchased.

The Atlantic Coast Company, of which Walter D. Noyes, Boston, Mass., is president and Lewis K. Thurlow, Boston, is treasurer, has leased the shipbuilding plant of Washburn Brothers at Thomaston, Me., and will immediately begin work on a four-masted schooner for Crowell & Thurlow, Boston, Mass.

The Philadelphia Ship Repair Company, Philadelphia, Pa., is planning to greatly enlarge its plant. F. J. McDonald, president of the company, states that work will soon be begun on the installation of a large floating drydock, machinery, etc.

The Todd Shipyards Corporation has been incorporated at Albany, N. Y., to take over the Robins Dry Dock & Repair Company, Brooklyn, N. Y., and the Tietjen & Lang Dry Dock Company, Hoboken, N. J. H. N. Dawson, F. W. Morrell and F. D. Riedlan, all of Brooklyn, are among those interested in the new concern.

The St. John Dry Dock & Shipbuilding Company, Ltd., has been organized in St. John, N. B., with a capital of $1,000,000, and is planning extensive building operations, the nature of which has not yet been divulged.

Lloyd W. Josselyn, librarian of the city of Jacksonville, Fla., writes MARINE ENGINEERING that several Jacksonville business men are planning to establish a shipbuilding plant with the intention of building large wooden schooners.

Preliminary work for the establishment of shipbuilding yards at Poplar Island on the Fraser River, B. C., has been undertaken by the Westminster Marine Railway Company, New Westminster, B. C. The company proposes to build a plant on the island to cost $70,000 and to install $15,000 worth of machinery.

The League Island Navy Yard, of Philadelphia, Pa., will be developed into a great naval base, according to statements by Franklin D. Roosevelt, Assistant Secretary of the Navy. The yard is assured of a new dry dock and it is probable that the proposed million-dollar chemical laboratory will be established at the yard.

Large American Shipyard to be Established on the Potomac River

Plans are being perfected by the recently organized International Steel & Shipbuilding Company, of New York and Washington, for the erection of a shipbuilding plant at Quantico, Va., which shall rival in size and output the leading shipyards in the United States.

The site selected for the new shipyard comprises 55 acres with a frontage of 2,400 feet, on the Potomac River. At this point the river is about three miles wide and there is a depth of water of from 35 to 40 feet just off the shipyard site. As the yard is located only 35 miles down the Potomac River from Washington and about 18 miles from Fredericksburg, Va., the site is accessible by rail connection to the principal Southern railroads and is bounded by their tracks.

Although the water frontage of the new yard will provide space for as many as twenty-four shipbuilding ways, only six will be erected at the start. At the same time, a main ship fitters' shop, 500 feet by 150 feet, will be erected and a mold loft and office building, 300 feet by 75 feet, and a machine shop 140 feet by 70 feet. The machinery will be operated by electric power secured from nearby power plants and the main shop will be equipped with three moving cranes, one of 10 tons' capacity and two of 5 tons' capacity. The six building ways will be equipped at first with temporary cantilever traveling cranes, although it is the intention of the company finally to fully equip the building ways with overhead traveling cranes.

It is understood that contracts have been secured for the construction of six general cargo steamers, each of 5,000 tons deadweight carrying capacity.

The directors of the new company are C. L. Ford and T. S. Stanton, of the Southern Boiler & Tank Works, Memphis, Tenn.; Thomas J. Shea, Portland, Ore.; G. A. Garrett, Washington, D. C.; James J. Shirley, manager of the foreign department of T. A. Gillespie Company, New York; Hugh McIsaac, vice-president Publicity Corporation, Washington, D. C., and H. T. Winfield, attorney, Washington, D. C.

The officers of the company are: Thomas J. Shea, Portland, Ore., president; C. L. Ford, vice-president and general manager; Hugh McIsaac, Washington, D. C., secretary and treasurer; James J. Shirley, New York, vice-president.

While the main offices and plant for the new company will be at Quantico, Va., offices will also be maintained at 50 Church street, New York, and Munsey Building, Washington, D. C.

Plant of the Sun Shipbuilding Company at Chester, Pa., Rapidly Nearing Completion

The Sun Shipbuilding Company, Third street and Delaware River, Chester, Pa., is rapidly completing the foundation work for shipbuilding ways and new shops for the yard. Concrete foundations for five shipways have already been started and two more will be begun at an early date. The foundations for the fabricating shops and ship sheds have been completed and it is expected that the buildings will be completed, the ways ready and much of the machinery and equipment installed by September 1. The plant covers a 60-acre tract. The main fabricating shop will cover 5 acres. A large and completely equipped boiler shop is also to be erected on the shipyard property and the plant of the Robert Wetherill & Co., Inc., which is owned by the shipbuilding company, and which will be used for the manufacture of machinery and engines, will be considerably enlarged. The present boiler shop equipment at the Wetherill plant will be moved to the new shop in the shipyard and all of the boiler and tank work will be done at that plant.

At the first meeting of the full board of the Sun Shipbuilding Company, held on July 5, Messrs. J. Howard Pew, Joseph N. Pew, Jr., William C. Sproul, Robert Haig and J. A. Sinn were appointed members of the executive committee. Robert Haig, formerly chief engineer for Lloyd's, will be general manager of the engineering department of the Sun Shipbuilding Company and president of Robert Wetherill & Co., Inc. Mr. Haig's principal assistant will be Henry J. Klaer, who will remain at the Wetherill plant with James H. Garthwaite as general manager of that plant. J. A. Sinn, formerly of the Fore River Shipbuilding Corporation, Quincy, Mass., has been appointed general manager of the hull construction and shipyard department. A. A. Howitz, formerly of the New York Shipbuilding Company, Camden, N. J., has been appointed chief engineer and W. Cunliff, formerly of the New York Shipbuilding Company, will be assistant chief engineer of the Sun Shipbuilding Company. A. B. Saunders, formerly of the New York Shipbuilding Company, Camden, N. J., has been appointed naval architect of the Sun Shipbuilding Company.

Large Oil Tanker Equipped with Fire Tube Superheaters

While there are about fifteen hundred steamers, representing over 2,000,000 horsepower, sailing from foreign ports equipped with firetube superheaters, the recent launching of the S. S. *Pearl Shell* at the shipyards of Harlan & Hollingsworth Corporation, Wilmington, Del., represents the first installation in a new steamer built in this country.

The *Pearl Shell,* an oil tanker, is to be operated by the Shell Oil Company, of San Francisco, and will sail out of New York harbor for the present at least. The vessel is over four hundred feet long, with a gross tonnage of over 5,600. She is equipped with three Scotch marine boilers fitted with Locomotive Superheater Company firetube superheaters, supplying superheated steam to triple expansion engines developing 2,400 horsepower.

The superheater was applied to the *Pearl Shell* after the purchasers had determined, to their own satisfaction, the economies and reliability in operation of a superheater of the same design, applied to one of their existing steamers of approximately the same size. They have also contracted for sufficient superheater equipment to convert five more of their existing ships.

Search for Fireproof Material for Deck Construction

The Bureau of Standards, Department of Commerce, in connection with a general study of fire-resisting materials, is considering among other phases of the subject the development of a fire-resisting material for use in constructing, in whole or part, the deck structures of excursion and passenger steamers. So far as may be applicable, the material when developed would also be considered in relation with other marine uses.

The Bureau of Standards would be glad to receive from manufacturers samples of such materials as they consider suitable for the purpose.

CORRECTION.—Under the illustration of the steamship *Eurana* on page 339 of the July issue, the caption, "S. S. *Eurana;* Equipped with De Laval Turbine Reduction Gears," is misleading, as, while the vessel is fitted with De Laval steam turbine-driven auxiliary units, it is not equipped with De Laval gears. The vessel is actually equipped with speed-reducing gears for propulsion, but they are not of the De Laval manufacture. The auxiliaries, however, include two 2-inch, 3-stage boiler feeders, each capable of supplying 100 gallons per minute, against 210 pounds pressure when driven at a speed of 3,450 revolutions per minute by a 38-horsepower velocity stage-impulse turbine, and two 10-kilowatt, 120-volt, direct-current generators, each driven by a De Laval turbine similar to those installed for driving the boiler feed pumps. The caption under the illustration referred to, therefore, should have read, "S. S. *Eurana,* equipped with De Laval steam turbine-driven auxiliaries."

Craig Engine Ordered for Large Auxiliary Schooner

An order for a 400 brake horsepower Diesel type engine to be installed in a large auxiliary schooner was recently placed through Messrs. Cox & Stevens, naval architects, New York, with the James Craig Engine & Machine Works, Jersey City, N. J. Two other makes of engines were ordered at the same time for vessels belonging to the same owner, but the Craig type was selected for the most powerful installation.

This schooner's main dimensions will be 239 feet by 40 feet beam and 19 feet draft loaded, and she will have a deadweight capacity of 2,000 tons. A speed of about 8 knots is contemplated with a Craig-Diesel type engine of 400 brake horsepower. Of the directly reversible type, this engine will have eight cylinders and will operate at about 240 revolutions per minute.

It is proposed to have the schooner in the transatlantic trade until the steamships overcrowd the Atlantic routes, and thereafter probably the vessel will be diverted to South American voyages. Normally her engine will be kept in operation, all possible additional benefit being derived from the wind, and the engine will only be shut down when there is a good stiff, favorable breeze to keep the vessel bowling along on her course at 8 knots or more.

A Craig-Diesel type engine of this power, it is claimed, will consume only about 14 barrels per day of 24 hours when operated at the maximum number of revolutions of the propeller wheel, but the regular practice of marine engineers being to operate the engines at very slightly less than full power, with practically no noticeable variation in the speed of the ship as a consequence thereof, the daily consumption can be reckoned at about 12 barrels. Under similar conditions a steamer would burn about 8 tons of coal per day.

Large Orders for Welin Davits

The United Fruit Company has placed orders with the Welin Marine Equipment Company, Long Island City, N. Y., for re-equipment of their whole fleet of passenger ships with Welin davits. Three of these ships, the *Pastores, Tenadores* and *Calamares,* were equipped with this type of davit when built and the equipment is proving so satisfactory that the United Fruit Company has placed orders to install similar equipment on all their ships.

The Welin Company also recently received davit orders for two passenger ships building for the Savannah line at the Harlan & Hollingsworth yards; for eight additional oil and freight ships building at the Union Iron Works, at San Francisco; for five additional ships building at the Chester Ship Building Company's plant; for four ships building for the Texas Steamship Company at their own yard; and for the steamship *Havana,* of the Ward Line, besides several other orders, including a number of ships of the Grace Line.

The boat department of the Welin Company is equally busy. Large orders for power lifeboats have been received from the United Fruit Company; also large orders for Lundin lifeboats from the Eastern Steamship Corporation of Boston. The Peninsular & Occidental Steamship Company, operating on the Gulf, is also adopting this type of boat.

Altogether, the Welin Marine Equipment Company has booked davit orders during the last six months to equip 116 ships, and many of these ships are also being equipped with Lundin lifeboats. In addition, standard lifeboat equipment and raft equipment is being furnished for about an equal number of ships, all of which tends to show the high quality and efficiency of the equipment furnished by this company.

Recent Launchings

The motor tank ship *Bramell Point,* under construction at the yards of the Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md., for the Vacuum Oil Company, New York, was launched on July 4.

The Merrill-Stevens Company, Jacksonville, Fla., launched on June 30 the twin screw gasoline lighthouse tender *Palmetto,* 90 feet long by 22 feet beam by 8½ feet depth, designed for service on the coast of North and South Carolina, Georgia and part of Florida.

The William Cramp & Sons' Ship & Engine Building Company, Philadelphia, Pa., launched on June 28 the oil tanker *J. M. Danziger,* of about 7,100 gross tons, which is under construction for the Petroleum Transportation Company, New York.

The Fore River Shipbuilding Corporation, Quincy, Mass., launched on July 20 the submarine *Isaac Peral,* which is being constructed for for the Spanish Government. The vessel is about 185 feet long, of 957 tons displacement.

The Manitowoc Shipbuilding Company, Manitowoc, Wis., launched on July 22 the steel steamer *Surveyor,* building for the United States Coast and Geodetic Survey.

PERSONAL

E. M. Salmon, formerly on the staff of the chief engineer surveyor of Lloyd's in London, has been appointed principal engineer surveyor of Lloyd's Register for the United States and Canada, with headquarters in New York.

J. A. Eden, Jr., has severed his connection with the Bausch Machine Tool Company, Springfield, Mass.

Holden A. Evans, formerly vice-president and general manager of the Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md., has been elected president of the company. Clement C. Smith, Milwaukee, Wis., has been elected vice-president; J. M. Willis, Baltimore, second vice-president; Edwin W. Poe, Baltimore, secretary, and George Allison, Baltimore, treasurer.

George A. Anthony, for eighteen years marine engineer in the quartermaster general's office of the Army Department, Washington, D. C., has resigned to engage in private business.

George E. Emmons, for twenty years plant manager of the General Electric Company, Schenectady, N. Y., was recently elected vice-president of the company.

H. Jasper Cox, formerly attached to the Lloyd's chief ship surveyor's staff in London, has been appointed assistant to the chief surveyor of Lloyd's Register for the United States and Canada, with headquarters in New York.

L. H. Mesker has been appointed sales manager of the Kearney & Trecker Company, Milwaukee, Wis., which manufactures the Milwaukee milling machines.

OBITUARY

John F. Hoffmire, Jr., superintendent and treasurer of the Roberts Safety Water Tube Boiler Company, Red Bank, N. J., died recently at his home in Red Bank, aged forty-seven.

William T. Fickett, retired shipbuilder, died at his home in Brooklyn, N. Y., on July 7, aged seventy-two.

Charles W. Moody, one of the men who helped build the ironclad vessel *Merrimac* for the Southern Confederacy, died on July 18 at New London, Conn., aged eighty-six.

Ernest C. Bliss, president and director of Bliss, Dallett & Co., of New York city, operators on the Red D Line of steamships, died suddenly at Manchester, Vt., on July 22.

Commodore Fred B. Dalzell, vice-president of the New York Boat Owners' Association, head of the Fred B. Dalzell Towing Company, Inc., and one of the best known steamship men on the Atlantic coast, died suddenly at his summer home in Amityville, Long Island, on July 16, aged fifty-four. For twenty-five years Commodore Dalzell was on the executive committee of the National Board of Steam Navigation and for two years its president. He was also chairman of the executive committee of the Board of Governors of the New York State Nautical School, chairman of the committee on rivers and harbors of the Maritime Exchange, and active in the affairs of the Chamber of Commerce of the State of New York, the New York Board of Trade and Transportation, the Merchants' Association, and the National Rivers and Harbors Congress.

Thomas Minor Lincoln, of New York city, whose death was noticed in our May issue, was born at Lewisburg, Pa., on September 1, 1854. During the Civil War he lived in Cincinnati, Ohio, and later attended public school in Boston, Mass., and the City College of New York. Before completing his college course, he left to enter the employ of the Pacific Mail Steamship Company. He was purser of the steamship *Georgia* of this line when it was wrecked in the Straits of Magellan, and commanded a boat that was rowed forty miles to Punta Arenas for help. He returned to the United States by the west coast of South America and Panama, where he inspected the railway and canal route for the company. He then entered the employ of the Clyde Steamship Company as purchasing agent, and later became, in addition, chief draftsman and assistant engineer of the line. He was obliged to resign in 1895 on account of ill health, after twenty-one years of faithful service. After his resignation he devoted himself to genealogy and historical research. Mr. Lincoln was a member of the Society of Naval Architects and Marine Engineers, the American Society of Naval Engineers, and numerous historical associations and fraternal orders.

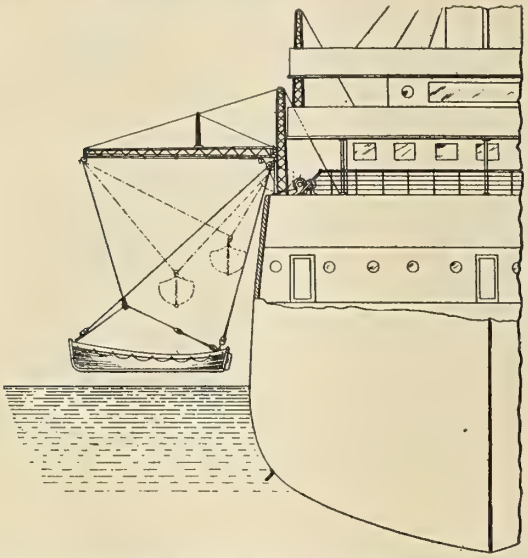
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents, compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,152,678. LAUNCHING APPARATUS FOR BOATS. SIGFRID NELSON WESSBERG, OF BROOKLYN, N. Y.

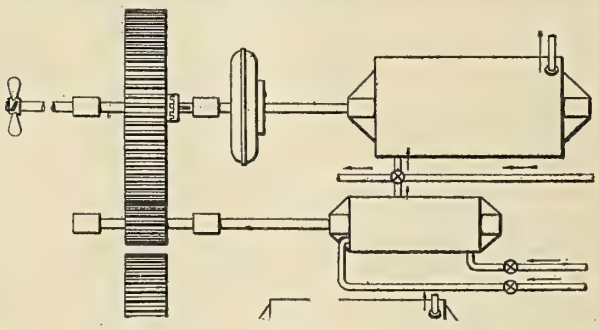
Claim 1.—A launching apparatus comprising a derrick located between tiers of boats on the deck of a ship and having a swinging boom adapted to extend beyond the ship's side more than the length of the boat to be launched, a lowering tackle on said boom, davits for supporting the boats, davit blocks and tackle connected with said davits and



adapted to be connected with the boat, a boat hung on said davit blocks, a detachable span connected to each end of said boat and provided with means midway its length for connection with the lowering tackle on the boom, one end of said span including a block and tackle whereby said end may be lengthened while the boat is being lowered. Five claims.

1,166,756. TURBINE POWER PLANT. HERMANN FOTTINGER, OF ZOPPOT, NEAR DANZIG, GERMANY.

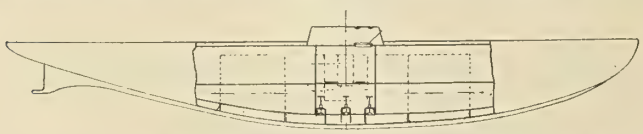
Claim 1.—A turbine plant including in combination a high pressure, high speed turbine, a low pressure, low speed turbine mounted for independent rotation, a driven shaft, mechanical gearing for transmitting



power from said high pressure turbine to said shaft and a hydraulic power transmitter for delivering power from said low pressure turbine to said shaft. Seven claims.

1,175,219. SUBMARINE BOAT. JOSEPH BARRAJA-FRAUENFELDER, OF BRIDGEPORT, CONN., ASSIGNOR TO THE LAKE TORPEDO BOAT COMPANY OF MAINE, OF BRIDGEPORT, CONN., A CORPORATION OF MAINE.

Claim 1.—A submarine or submersible boat, having a middle main ballast-tank the center of volume of which is in substantially vertical alinement with the center of gravity and center of buoyancy of the

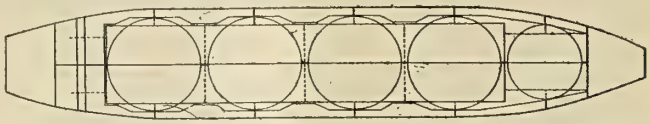


boat, forward and after main ballast-tanks having their center of volume in substantially the same longitudinal vertical plane with the center of gravity and center of buoyancy of the boat, auxiliary tanks arranged at the sides of the boat, and final adjusting tanks arranged in said auxiliary tanks and final adjusting tanks being in the same transverse plane with the center of gravity of the boat. Eight claims.

British patents compiled by G. F. Redfern & Co., chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn place, W. C., London.

15,748/15. TANK STEAMERS. SIR W. G. ARMSTRONG, WHITWORTH & CO., LTD., AND R. S. WHITE, OF THE WALKER SHIPYARD, NEWCASTLE UPON TYNE.

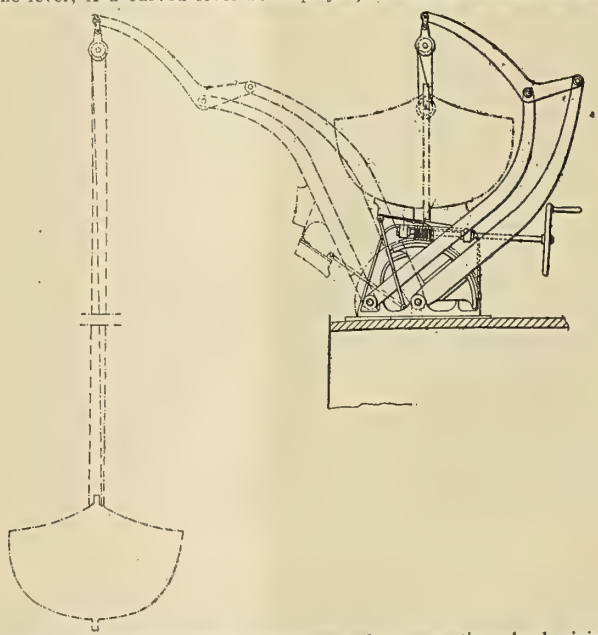
This invention relates to tank steamers such as are used for carrying liquid in bulk of the type in which bottomless tanks are connected to and extend upwards from the bottom plating of the ship. Its object is to furnish a vessel of simple and strong construction in which as much space as possible shall be available for carrying the cargo. According to this invention each bottomless cylindrical tank is supported on two longitudinal girders and on two transverse girders or floors (or on a keelson connected thereto), shelves forming the bottom of the tank where it overlaps the girders, and plates being secured to the longitudinal and transverse girders outside the cylindrical walls of the tanks.



Each cylindrical tank is thus in communication with a rectangular space extending right down to the bottom of the ship, and bounded by the two longitudinal girders and by two transverse girders, but otherwise unobstructed. Auxiliary tanks are also provided, each being bounded by the side of the vessel, by the sides of two main tanks, by two transverse partitions and by a central longitudinal partition.

5,370/15. DAVIT FOR MANIPULATING SHIPS' BOATS. M. F. TEMPLE AND G. H. GRAHAM, BOTH OF LONG ROW, THRIFT STREET, SOUTH SHIELDS.

The drawing is an end view showing a davit in its inboard position in full lines and its outboard position in dot-and-dash lines. The davit consists of a curved crank lever pivoted to the upper end of a second lever, which may be curved as shown, or straight, fulcrummed at the outboard side of base plate, which forms the attachment of the device to the ship's deck. The lever may be single, or may be formed of two plates parted by distance pieces, or of two plates riveted together for a portion of their length to form a forklike lever, distance pieces if desired, being arranged in the fork portion of said lever. The longer member of the lever is provided with an eye or eyes at its furthest extremity for carrying the boat falls or tackle, while the shorter arm is pivoted to the upper end of a third lever, which may be curved as shown, or straight, mounted on a shaft pivoted in bearing on the base plate aforesaid, and inboard relatively to the lever. Fixed to the lever so as to move therewith is a toothed quadrant gearing with a worm or endless screw, the spindle of which is mounted in bearings on the standard on base plate, and operated by a hand wheel or like device, so that by rotating the quadrant by the worm aforesaid the lever may be moved from its position leaning inboard, which is normal when the boat rests upon the chocks, to an outboard position when the boat is to be launched or lowered clear of the ship's side. The curve of the lever, if a curved lever be employed, is such as to clear the boat



when stowed and said lever has one part of a supporting chock rigidly attached to it to receive said boat when stowed, while the other and outboard half of said chock is hinged thereto and supported and actuated by a link or stay pivoted to the base plate. The base plate is arranged to carry each davit as a separate structure, thus allowing them to be fitted to any required span. To prevent any strain or side movement and to assist in the more perfect working, the quadrant is provided with a boss which carries a pin riding in an arc-shaped slot in the standard, a nut on the outer end of said pin assisting in maintaining the quadrant's even working. In operation the partial rotation of the quadrant by the rotation of the worm moves the lever outwards, which carries outboard with it the lever which supports the cranked lever bearing the boat into the position shown in dot-and-dash lines. At the same time the shorter arc described by the link connecting the base plate with the hinged half of the chock, causes said hinged half to clear the boat during its outward movement. The endless screw or worm being of small pitch acts as a regulator and brake to prevent slipping.